SIEMENS

MULTIMOBIL 5C

SP

Troubleshooting Guide

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Service Instructions

Version 5.0

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1 Safety

1.1 Safety Precautions

WARNING	Before opening / closing the covers ensure that the mains is switched off and the plug is removed from the socket. Ensure that the protective earth connections of the sub assemblies are properly connected.

WARNING	Precaution should be observed while working on the single tank. During continuos fluoroscopy, the temperature of the oil in the single tank raise. The thermal switch provided on the single tank cuts off the radiation after the temperature is reached to 60+5°C. Hence the surface becomes hot and can cause burns. Avoid contacting the surface of the single tank at this instance.

1.2 Overload Protection

The unit is designed to work on 110 / 190-240V, single phase, 15A socket. For safety purposes 16A HRC fuses are provided which will blow when a current exceeding 16A sustains for its response time.

WARNING	**Ensure that the mains socket is properly earthed.**

In case of fault if the kV tries to build beyond the safe limit of X-ray tube the protection circuit blocks the HT.
In case of fault if the Filament current tries to increase beyond the safe limit the protection circuit blocks filament boosting.
Maximum permissible resistance between the Earthing lead terminal in the control and on the HT transformer shall not exceed 0.1 ohms.

1.3 Radiation Protection

WARNING	• Do not put any part of your body in the direct line of radiation. Collimate the X-ray beam. • Keep maximum possible distances from the object being radiographed. For this make the best use of 5 mtr of recoilable hand held exposure release switch. • In the room, wear protective clothing (lead Apron). • Monitor radiation received using the personal TLD-badges or pen-dosimeter.

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1.4 Measuring with oscilloscope

For normal working, the protective earthing of mains must not be removed.
In case system noise is getting coupled to the scope, use the scope in differential mode.
To measure high voltage use DIFFERENTIAL probe isolated from ground.

1.5 Handling precautions

1. Strictly observe ESD precautions while handling PCBs and ESD sensitive devices.
2. After the unit is switched on, the capacitors charge to 300VDC. (Approx) After switching the unit OFF, it takes about 4 minutes for capacitors to discharge. Green LED on D61 indicates the presence of DC voltage.
3. Lead is used for radiation protection inside the single tank. The collimator flaps are made of lead. Lead rings are used on the Image intensifier for counter balancing. Lead is used inside the C-arm profile for counter balancing. Hence, special precautions should be observed during handling these parts to avoid lead poisoning and contamination.
4. If the Temperature of the single tank exceeds 65°C, then the Temperature. Sensor (switch) operates and D915 blocks the firing pulses to the inverter. This overload protection will automatically again switching ON after the temperature of single tank goes below the threshold level (65°C) of the thermal switch which is indicated by the thermometer symbol on the top panel. Cool-down periods are recommended if used extensively.

1.6 Mechanical Safety

Due to the manoeuvrability of the system, the collision probability of the image intensifier and the single tank with the patient or the table is greatly increased if adequate care is not taken.

While moving various parts of the unit with hand, use of handgrips and handles is recommended. The figure shows location where there is a danger of crushing for patient or user due to parts moving relative to each other.

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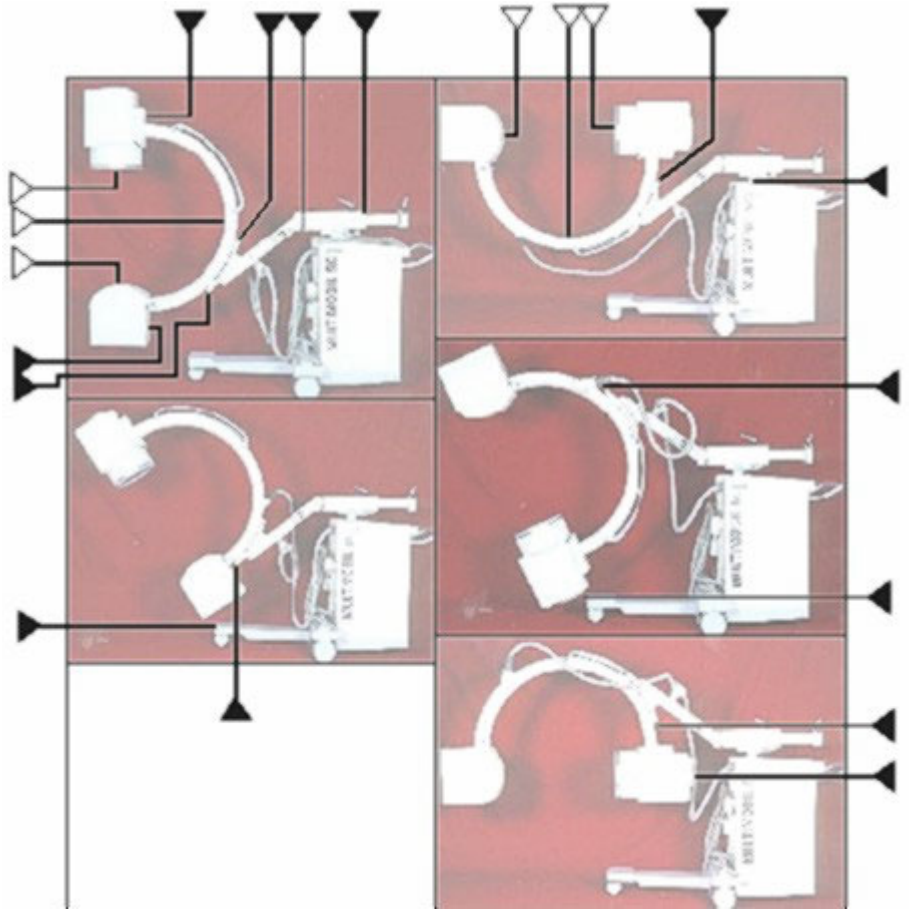

The system should be moved only manually, by the handles provided for this purpose. whenever exceptions must be made , note the points of potential injury between the movable system parts and their guide openings. The system areas marked in the drawings indicate points of crushing or impact hazards for the patient or the operator.

▼ Points of injury for operator ▽ Points of injury for patients.

Note: The system shown above is with 9“ II system. The points of injury are identical for 6“ II system.

1.7 Maintenance

All parts, modules of this product must be tested, inspected, for performance and safety aspects every 12 months to ensure that the product functions properly and is safe for patients, operating personnel and other persons.
Every 12 months, trained technical personnel should inspect and if necessary replace system components of the generator, which may result in hazard due to excessive wear and tear.
If more frequent inspections and maintenance are required by federal or local regulations, ensure compliance with them.

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1.7.1 Product Disposal

Legal regulations may contain special prescriptions concerning the disposal of this product. In order to avoid environmental damage and/or personal injury, please inform SIEMENS Customer Service if you want to put the unit out of operation and dispose it.

CAUTION	This product is governed by WEEE directive. Please contact SIEMENS Customer Service for proper disposal.

1.7.2 Radioprotection Material

Lead is present in X-ray tube assembly, In the C-arm profile, In the Image intensifier and in Collimator, Approx.10 kg.
As a precaution against lead poisoning, avoid direct contact with lead.

1.7.3 Transformer Oil

Oil in X-ray tube assembly, approx. 10.5 Ltr.

1.7.4 Plastics

Epoxy resin on PC boards, PVC of cables approx. 5 kg.

1.7.5 Electrolytic Capacitors

These capacitors must be discharged. Please inform the Siemens Customer Service.
Electrolytic Capacitors, approx. 5.5 kg.

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2 Servicing

2.1 Tools and measuring instruments required

- Usual service tools
- Digital Multimeter
- 2 channel storage oscilloscope
- mAs meter
- Megger
- Radiation detector
- Mechanical tool kit containing set of spanners, screwdrivers, Allen keys etc.

	During Oscilloscope operation the protective ground wire connection in the power cable must not be interrupted under any circumstances.

2.2 Replacing damaged or missing screws

Damaged or missing screws should only be replaced with screws having similar parameters as that of the original. An ornamental screw should be replaced with an ornamental screw only for retaining the aesthetic value where as a nickel-plated screw/bolt should be replaced with a nickel plated screw/bolt with same specification (size, material and tensile strength) as that of the original screw/bolt.

2.3 Cleaning and Disinfecting

The unit must always be switched OFF or disconnected before cleaning.
Use only water or a Luke warm mixture of a household cleaner diluted with water to clean the unit.
Do not use an abrasive or organic solvents or cleaning agents containing solvents such as gasoline used for cleaning purposes, alcohol or stain remover. Do not spray water on the unit.

2.3.1 Cleaning the Unit

Switch OFF the system prior to cleaning, disinfecting, or sterilizing.
Clean the stand with a damp cloth or cotton pad.
Dampen the cloth or pad with water or lukewarm, diluted commercially available liquid cleaning solution.

CAUTION	Do not use scouring powder, organic solvents (may damage materials) or solvent based cleaning fluids (benzene, alcohol, spot remove). Do not spray on the unit. The cleaning fluid must not seep into the generator.

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2.3.2 Disinfecting

CAUTION	As is commonly known, the ingredients in disinfectants are hazardous to your health. Ensure that the room is well ventilated when using any disinfectant. Follow manufacturer's instructions for the use of the product.

To disinfect surfaces, we recommend common liquid solutions of aldehyde- based or ampholytic surfactant -based disinfectant.

CAUTION	Substituted phenol based or chlorine-releasing disinfectant can weaken materials and are not recommended. The same restrictions apply to undiluted solutions with high alcohol content (e.g. for disinfecting hands). Disinfectant sprays should generally not be used, the spray can seep into the system, and safety features can no longer be guaranteed (possible damage to electrical components, formation of flammable mixtures of air and the solution vapour).
WARNING	As is known, some components of disinfectants are detrimental to health. Their concentration in respiratory air must not exceed a legally determined limit. We recommend that appropriate directions on use issued by the manufacture of these agents be strictly observed.

2.4 Protecting the system from fluids

Do not allow fluids to enter the system either during normal operation or during cleaning and disinfections, as this may damage the system or cause a system malfunction.

NOTICE	The Sheet metal cabinet of the control unit is not watertight. The cleaning fluid should not seep into the unit. Seepage of fluid into the unit can result in malfunctioning of the electronic components

2.5 Routine Checks

The Service personnel should perform the checks detailed in this section.

2.5.1 Daily checks

2.5.1.1 Prior to the Operation

Check that all safety related devices are functional and that the system is ready to operate.

Please check:

- The power cord. Do not use the unit if the power cord is damaged.
- The additional conductive connection between the system and point of Potential equalization, e.g. the patient table, must be established prior to the examination.

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- All the mechanical movements of the unit.
- All the locking mechanism of the unit.
- The correct functioning of the foot brakes, the steering mechanism of the unit and the monitor trolley.
- The anchoring of housing at the II unit and at the single tank.
- Check for the emergency stop function for motor-driven system movements.

Switch the system on

Move the lifting column.
Press the EMERGENCY STOP button.
Lifting column movement is not possible.
Press the Emergency stop button provided on the control unit of the Multimobil 5C immediately if any dangerous situation arises from motorized movements.
The motorized vertical movement will then be disabled immediately
This does not affect all other system functions
Unlocking: Unlock the button only after the danger has been eliminated.
You can unlock the button by turning it gently anti-clockwise.

2.5.1.2 During operation

Check for:

- The radiation indicators for correct functioning.
- All the audio-visual indicators for correct functioning.
- All the modes of operation proper functioning.
- Proper positioning of the unit.
- When moving the system, remove any obstacles on the floor that may block the wheels (Cable deflectors are provided).
- The exposure indicator and audible signal during Radiography and during Fluoroscopy.

Switch the system "OFF" immediately if a live image appears on the monitor or the radiation indicator glows although the radiation release switch is not activated.

2.5.2 Monthly checks

Check the manoeuvrability of the unit.
Check the round connector connecting Monitor Trolley and C arm Trolley.
Check function of all locking lever.
Check the legibility of the labels according to those in section Location of Labels.
If any labels require to be replaced, please notify Siemens customer service.

2.5.3 Performance Check (Every Six months)

- Check Counterbalancing of the C -arm at each position.
- Take a sample exposure at 60 kV, 10 mAs.
- Check for Radiation indication LED, the lamp on the monitor trolley and the Audio indication in form of Buzzer.
- Check the automatic dose regulation

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a) Close the collimator and cover single tank with multifold lead apron and switch on the fluoroscopy in ADR mode. The kV and mA should reach to the maximum.

b) Open the collimator and remove all objects from the x- ray beam path and switch on the Fluoroscopy in a ADR mode. The kV and mA should reach to the minimum.

- Check the image intensifier function including camera functions.

a) Last Image Hold

b) Zoom In / Out

c) Image Reversal (Horizontally)

d) Image Reversal (Vertically)

e) Memory Selection

f) Image Transfer (Memory write / Overwrite)

g) Image rotation clockwise.

h) Image rotation Counter Clockwise.

2.6 Calibration Check

2.6.1 Control Voltages

Voltage	Measuring Point	Range
+5 V	D915.X15.4 & GND	4.9 to 5.2 V
+15 V	D915.X15.5 & GND	13.5 to 16.5 V
-15 V	D915.X15.7 & GND	-13.5 to –16.5 V
+15 V (For Filament)	D506 X4.7 & 8	+15 V
+24 V (For Filament)	D506 X4.6 & 8	+24 V
+12 V	D505 TP. +12V & OVL	11.7 to 12.3 V
+5 V Collimator Supply	D505 TP. +5V & OVL	4.8 to 5.2 V

2.6.2 Signals

Signal	Measuring Point	Range	Adjustment
KVsoll	D915.TP.KVS During Exposure	2.0 ± 0.1 V for 60kV	D915.P7
mAsoll	D915.TP.JRS During Exposure	2 .0 V ± 0.1 V for 40mA	D915.P6
IH	D915.TP. IH During Standby	1.5 V ± 0.2 V	D915.P5
	During Preparation	2.8 V ± 0.3 V	
Exposure	mAs link (by mAs	For e.g. @ 60 kV, 10mAs	D915. P1

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Signal	Measuring Point	Range	Adjustment
time	meter) During exposure	Time 238 – 262 msec (Refer to the Exposure charts section for various combinations of kV & mAs for units with 190-240V and units with 110V.	
Cal	D915.TP. CAL point During switching on	1.25 to 1.5 kHz	D915.P3
Reg	D915.TP.REG point During Service Mode	9.2 kHz ± 0.3 kHz	D915.P4

2.6.3 Exposure

- Switch the generator ON.
- Set exposure parameters 60KV, 10mAs.
- Pull the recoilable hand held exposure release switch and release an exposure.
- The Amber colored LED on top panel lights up for a short duration equal to exposure time and an audible indication by a Buzzer from the control.
- The LED's on D915 light in the following sequence:
- Select the one step Exposure release switch. Internally First Press & second press stages are activated. This corresponds to Preparation & Exposure stage with green LEDV22 & Yellow LED V23 glowing respectively.
- In case of error Red LED V24 on D915 lights and error code corresponding to the error is displayed.

2.6.4 Timing

- Set any exposure parameter as per the exposure chart.
- Take an exposure and note down the kV and mA wave form in the oscilloscope.
- Check for the timing of exposure.
- It should be within ±5% of the value defined in the exposure chart.

2.6.5 kVp Measurement

The kVp measurement can be carried out either by kVp-meter or by electrical measurement.

2.6.5.1 kVp-meter

- Switch the unit ON.
- Place the kV sensor over the single tank and connect the cable to the meter.
- Set the kVp meter at 12pulse and 55-85kV ranges.

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- Set exposure parameters as 60kV 20mAs.
- Release an exposure.
- The readings should be within ±5% of the selected value.
- Repeat with meter setting 77-150kV and exposure parameter setting as 90kV 20mAs.

2.6.5.2 Electrical

- Connect oscilloscope at D915.TP.kV.
- Set the exposure parameters as 60kV, 2.5mAs.
- Release an exposure.
- The recorded waveform should be within ± 5% of the set value. (1V ⇒ 20 kV)
- Repeat with 90kV 1.6mAs.

2.6.6 mA / mAs Measurement

- mAs measurement could be carried out either by mAs-meter or by electrical measurement.

2.6.6.1 mAs-meter

- Remove mAs link on D506.
- Insert mAs-meter leads in the banana sockets mA+ and mA- on D506.
- Set meter at DC mA, 200mAs and in the mAs mode.
- Set exposure parameters as 60kV 20mAs.
- Release an exposure.
- The reading should be within ± 5% of the selected value.
- Repeat for exposure parameters 90kV 16mAs.
- The actual tube current can be measured by setting the meter in mA mode.
- Set the exposure parameters as 60kV 50mAs.
- Release an exposure.
- During the exposure, the reading should be within ± 5% of the mA as per the exposure chart.

2.6.6.2 Electrical

- Connect oscilloscope at D915.TP.JR.
- Set exposure parameters 60kV 2.5mAs.
- Release an exposure.
- The recorded waveform should be within ±5% of the mA as per the exposure chart. (1V⇒20mA)

2.6.7 Tuning

It is necessary to re-tune the unit in case of undershoot or overshoot observed in the mA wave shape.

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Tuning is required when any of the following Part is changed.

1. Single tank.
2. D915 PCB
3. D506 PCB

2.7 Yearly Checks

The following test has to be performed every year. Siemens offers free service for during the first year and attractive AMC packages are available.

a) Check for the calibration values.

b) Check for insulation resistance of the equipment (process explained below)

   1. Short the live and neutral terminal at mains cable end.
   2. Select the range of Megger 500V DC.
   3. Connect the probes of Megger between earth and shorted live and neutral terminal.
   4. Switch ON the Megger and note down the value of insulation resistance when the value (reading) stabilises.
   5. The value should be greater than 10MΩ

c) Check the parts subject to wear and tear.

2.8 Parts Subject to Wear

1. Overlay
2. Power cord,Power Plug.
3. Exposure cord
4. Brake linings
5. X-ray tube
6. Image intensifier
7. Wheels
8. Stickers and symbols
9. Bearings,Rollers etc
10. Sprockets
11. Handles and knobs.
12. False covers
13. Threaded spindle and Threaded Bush

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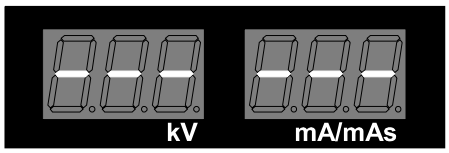
2.9 Checks prior to switch ON after prolonged shelf life

The following sequence to be followed when the unit is switched on after 6 months of shelf life.

2.9.1.1 Forming of capacitors

If the unit is being installed after six months from the date of dispatch, the capacitors need forming.

1. Switch ON the unit.
2. The display will be as shown.



3. Observe the gradual build up of DC voltage across the capacitors in the inverter module.
4. Switch off the unit after the capacitor voltage reaches 150V DC.
5. Switch on the unit again.
6. Keep it on till the capacitor voltage reaches 250V
7. Repeat the above procedure for 5 times.
8. Switch on the unit and after 9 Secs the US contactor picks up
9. The voltage across the capacitors should be around 300-350V DC

2.9.1.2 Gattering of Image Intensifier.

Keep the unit on in standby mode for 30 minutes before generating x-rays.

2.10 Checks prior to transport

Functional check of the brakes. Lock the brake. It should not be possible to move the Multimobil 5C with normal hand power. A slight slip is acceptable when using greater force.

Should any fault be observed, please notify Siemens customer service.

Note : Annual Maintenance must be performed as per the guidelines described in the Maintenance section.
Notify Siemens Customer Service if you do not have a maintenance contract.

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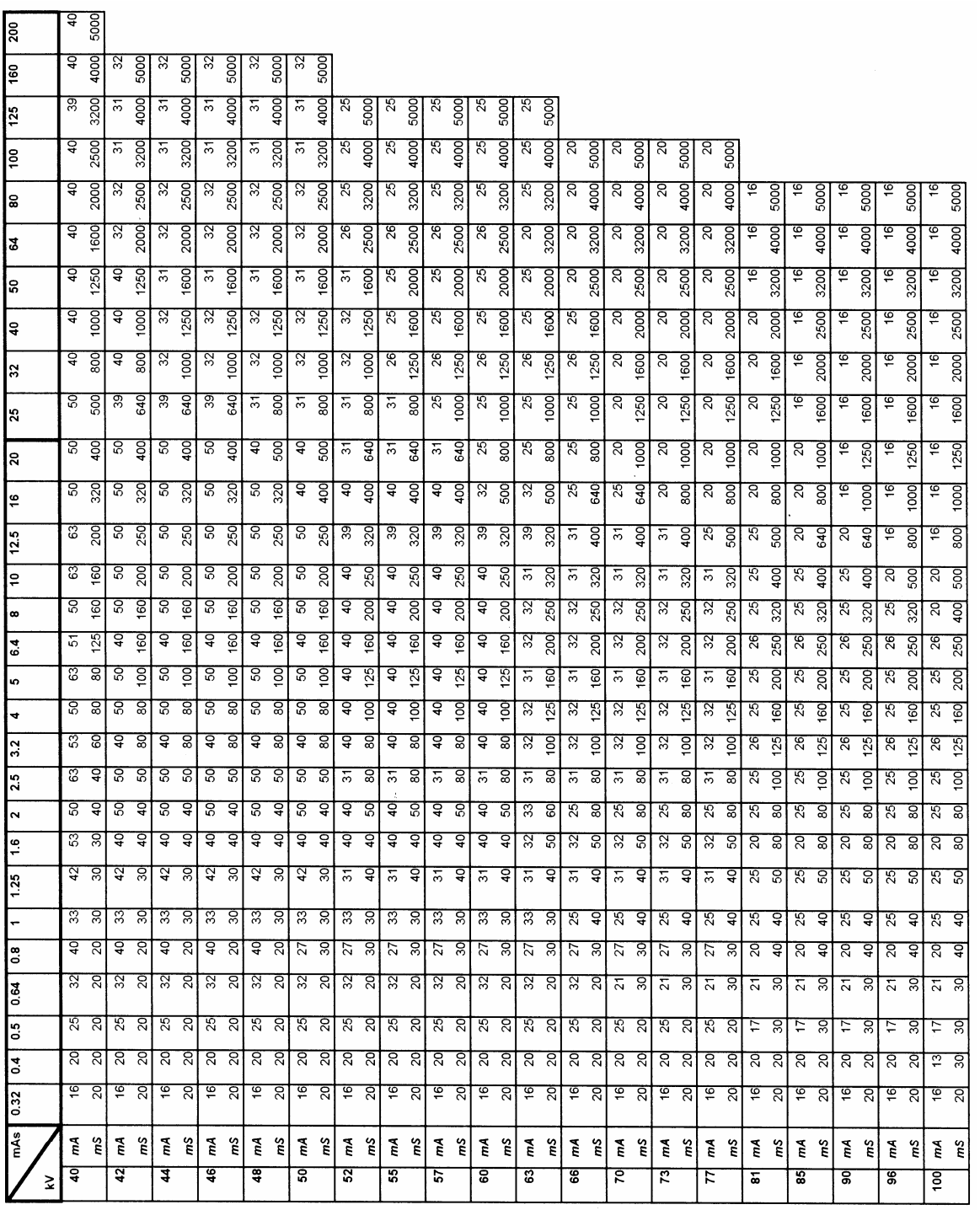
3 Exposure Charts

3.1 For units with 230V input



kV	mAs	0.32	0.4	0.5	0.64	0.8	1	1.25	1.6	2	2.5	3.2	4	5	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200
40	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
42	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
44	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
46	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
48	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
50	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
52	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
55	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
57	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
60	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
63	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
66	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
70	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
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73	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
77	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
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81	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
85	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
90	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
96	mA	16	20	25	32	40	33	42	53	50	63	53	50	63	51	50	63	63	50	50	50	40	40	40	40	40	40	39	40	40
	mS	20	20	20	20	20	30	30	30	40	40	60	80	80	125	160	160	200	320	400	500	800	1000	1250	1600	2000	2500	3200	4000	5000
100	mA	16	13	17	21	20	25	25	20	25	25	26	25	25	26	20	20	16	16	16	16	16	16	16	16	16	16	16	16	16
	mS	20	30	30	30	40	40	50	80	80	80	125	160	200	250	320	500	800	1000	1250	1600	2000	2500	3200	4000	5000				

Exposure Chart for units with 230V input

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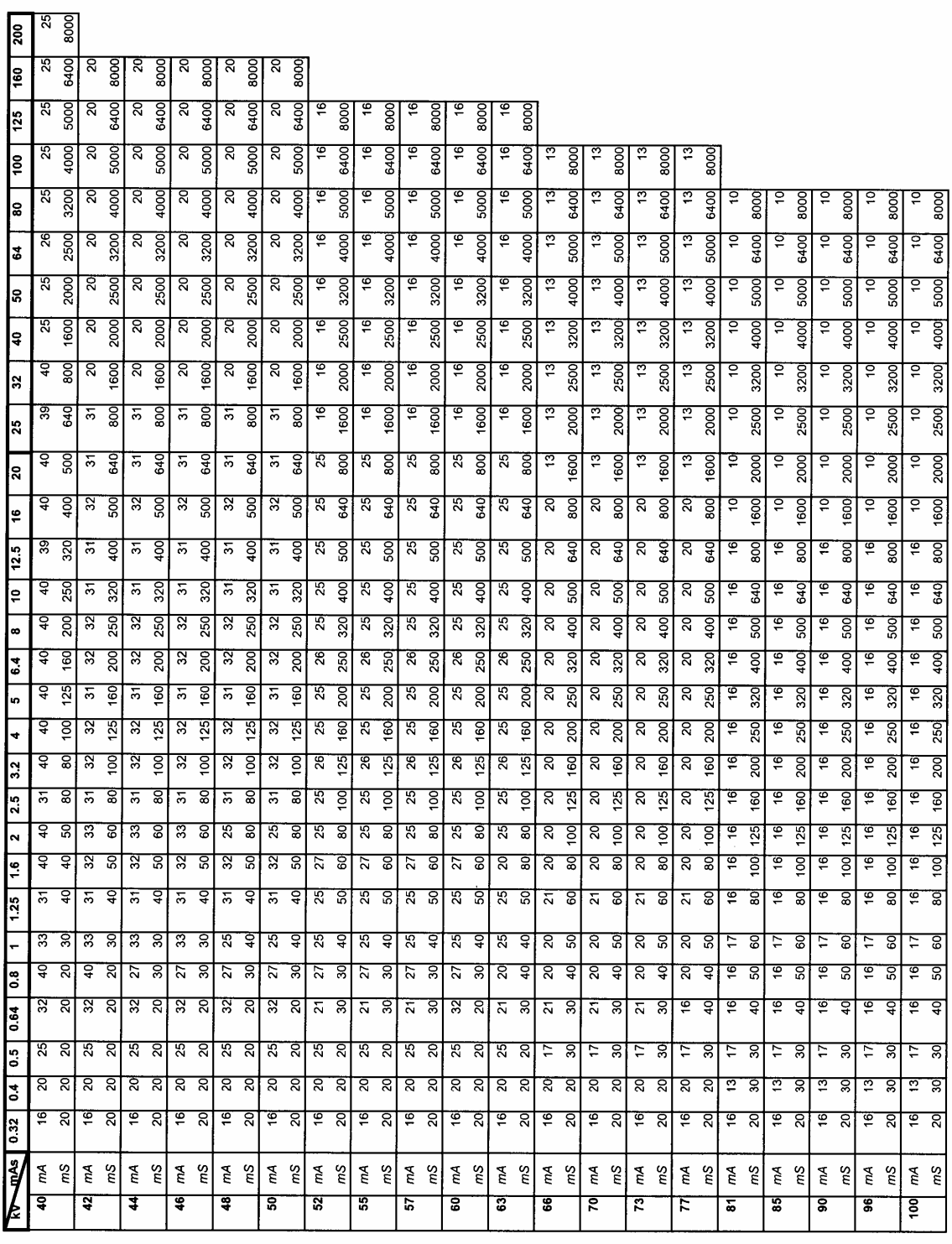
3.2 For units with 110V input



kV	mAs	0.32	0.4	0.5	0.64	0.8	1	1.25	1.6	2	2.5	3.2	4	5	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200
40	mA	16	20	25	32	40	33	31	40	40	31	40	40	40	40	40	40	39	40	40	39	40	25	25	26	25	25	25	25	25
	mS	20	20	20	20	20	30	40	50	50	80	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000
42	mA	16	20	25	32	40	33	31	40	40	31	40	40	40	40	40	40	39	40	40	39	40	25	25	26	25	25	25	25	25
	mS	20	20	20	20	20	30	40	50	50	80	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000
44	mA	16	20	25	32	40	33	31	40	40	31	40	40	40	40	40	40	39	40	40	39	40	25	25	26	25	25	25	25	25
	mS	20	20	20	20	20	30	40	50	50	80	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000
46	mA	16	20	25	32	40	33	31	40	40	31	40	40	40	40	40	40	39	40	40	39	40	25	25	26	25	25	25	25	25
	mS	20	20	20	20	20	30	40	50	50	80	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000
48	mA	16	20	25	32	40	33	31	40	40	31	40	40	40	40	40	40	39	40	40	39	40	25	25	26	25	25	25	25	25
	mS	20	20	20	20	20	30	40	50	50	80	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000
50	mA	16	20	25	32	40	33	31	40	40	31	40	40	40	40	40	40	39	40	40	39	40	25	25	26	25	25	25	25	25
	mS	20	20	20	20	20	30	40	50	50	80	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000
52	mA	16	20	25	21	27	25	25	27	25	25	26	25	25	26	25	25	25	25	25	16	16	16	16	16	16	16	16	16	16
	mS	20	20	20	30	30	40	50	60	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000		
55	mA	16	20	25	21	27	25	25	27	25	25	26	25	25	26	25	25	25	25	25	16	16	16	16	16	16	16	16	16	16
	mS	20	20	20	30	30	40	50	60	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000		
57	mA	16	20	25	21	27	25	25	27	25	25	26	25	25	26	25	25	25	25	25	16	16	16	16	16	16	16	16	16	16
	mS	20	20	20	30	30	40	50	60	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000		
60	mA	16	20	25	32	40	33	31	40	40	31	40	40	40	40	40	40	39	40	40	39	40	25	25	26	25	25	25	25	25
	mS	20	20	20	20	30	40	50	60	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000		
63	mA	16	20	25	21	27	25	25	27	25	25	26	25	25	26	25	25	25	25	25	16	16	16	16	16	16	16	16	16	16
	mS	20	20	20	30	30	40	50	60	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000		
66	mA	16	20	17	21	20	20	21	20	20	20	20	20	20	20	20	20	20	20	20	13	13	13	13	13	13	13	13		
	mS	20	20	30	30	40	50	60	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000			
70	mA	16	20	17	21	20	20	21	20	20	20	20	20	20	20	20	20	20	20	20	13	13	13	13	13	13	13	13		
	mS	20	20	30	30	40	50	60	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000			
73	mA	16	20	17	21	20	20	21	20	20	20	20	20	20	20	20	20	20	20	20	13	13	13	13	13	13	13	13		
	mS	20	20	30	30	40	50	60	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000			
77	mA	16	20	17	16	20	20	21	20	20	20	20	20	20	20	20	20	20	20	20	13	13	13	13	13	13	13	13		
	mS	20	20	30	40	40	50	60	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000			
81	mA	16	13	17	16	16	17	16	16	16	16	16	16	16	16	16	16	16	16	10	10	10	10	10	10	10	10			
	mS	20	30	30	40	50	60	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000				
85	mA	16	13	17	16	16	17	16	16	16	16	16	16	16	16	16	16	16	16	10	10	10	10	10	10	10				
	mS	20	30	30	40	50	60	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000				
90	mA	16	13	17	16	16	17	16	16	16	16	16	16	16	16	16	16	16	16	10	10	10	10	10	10	10				
	mS	20	30	30	40	50	60	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000				
96	mA	16	13	17	16	16	17	16	16	16	16	16	16	16	16	16	16	16	16	10	10	10	10	10	10	10				
	mS	20	30	30	40	50	60	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000				
100	mA	16	13	17	16	16	17	16	16	16	16	16	16	16	16	16	16	16	16	10	10	10	10	10	10	10				
	mS	20	30	30	40	50	60	80	100	125	160	200	250	320	400	500	640	800	1600	2000	2500	3200	4000	5000	6400	8000				

Exposure Chart for units with 110V input

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4 Error Codes

Initialisation Error Codes		
90	EPROM Checksum Failure	The EPROM Checksum is stored at 7FFEh and 7FFFh as a 16-bit word. During self-Diagnostics the software calculates the checksum of the EPROM and compares with the stored checksum.
96	kVsoll Failure	During Self-Diagnostics the software outputs 7Fh to the D/A converter (B). The 2.5V at the output of the D/A converter is Read by the µC through Analog Port 4. The value read should be greater than 7Ah and less than 86h. (I.e. between 2.39V and 2.62V)
97	JRS Failure	During Self-Diagnostics the software outputs 7Fh to the D/A converter (A). The 2.5V at the output of the D/A converter is Read by the µC through Analog Port 3. The value read should be greater than 7Ah and less than 86h. (I.e. between 2.39V and 2.62V)
99	Last Reset by watchdog Timer	The built-in Watchdog timer (WDT) is reset by the software every 25 msec. If due to some failure the software doesn't reset the WDT, the WDT in turn will reset the µC after 65 msec.
Standby Error CodEs		
02	+15V Supply Error	The +15V supply from SMPS is polled by the µC through Analog port 0. The +15V supply should be between +12V to +18V.
03	Iheiz < Istby	The Filament Standby current is 1.5A. Iheiz read by the µC through Analog port 2 should be greater than 1.25A. i.e. 1.25V (Iheiz ratio : 1V = 1A)
04	Iheiz > Istby	The maximum value of Standby current permitted is 1.8 A.
05	kVist <> 0	kVist is read by the µC through Analog port 7. During Standby the value of kVist read should be Zero. (kVist ratio : 1 V = 20kV)
06	JR <> 0	JR is read by the µC through Analog port 1. During Standby the value of JR read should be Zero. (JR ratio : 1 V = 20mA)
33	Main Inverter Short Circuit	In standby mode if the Main Inverter Driver (Cable) is disconnected this error gets activated.
Exposure Error CodEs		
11	Main Inverter Short Circuit	This error is displayed when the drivers of the Main Inverter detect short circuit.
12	kVist > kVmax	The PkV is monitored for Max.115kV. If the actual value of kV is greater than this i.e. if the voltage cross 3.83V error is displayed.
13	Iheiz > Imax OR JR > Jrmax	Maximum value of Iheiz above which error will be displayed is 4.0 A (4.0V). Maximum value of mAist is 71mA above which error is displayed.
14	kVist < kVsoll	kVist is continuously polled during exposure. The value of kVist should be greater than 85% of kVsoll
15	JR < JRS	JR is continuously polled during exposure. The value of JR should be greater than 50% of JRS.
17	Backup Timer	This error is displayed if regular means of terminating exposure fails and the backup timer terminates exposure. The backup timer value is set to 2 * mSec +100
18	Premature Exposure Termination	Exposure Release Switch is released before the mAs Integrator terminate the exposure.
21	Iheiz> Iheiz max	This error is displayed if Iheiz exceeds the Iheiz max value.
22	Maximum Preparation Time	This error is displayed if exposure mode is not entered by the system after exposure switch selection for more than 15 sec because of hardware failure.
51	kVist < kVsoll (Fluoro)	Same as Code 14. This Error is displayed only during Fluoroscopy.
52	JR < JRS (Fluoro)	Same as Code 15. This Error is displayed only during Fluoroscopy.

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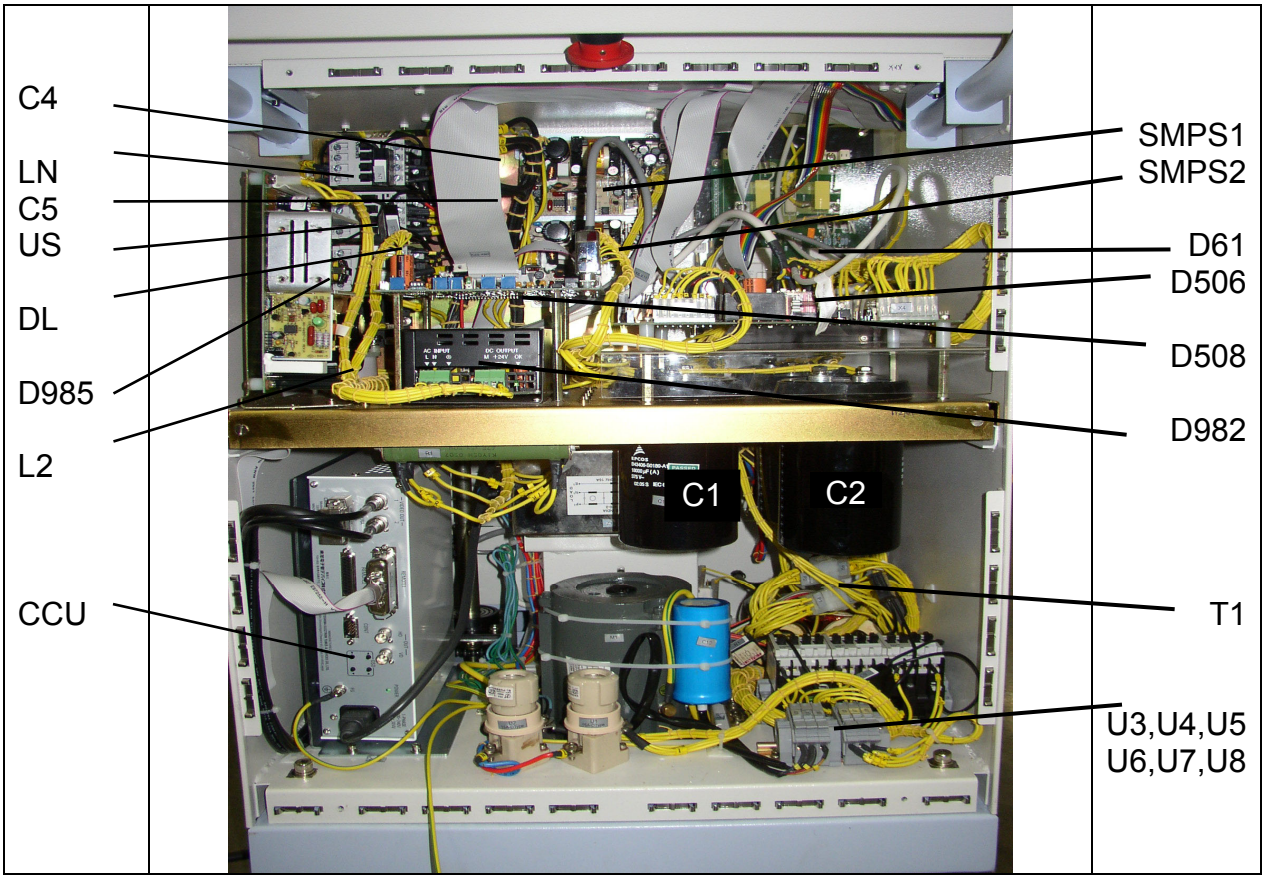
5 Troubleshooting

Troubleshooting In case of errors, which Impair radiography or fluoroscopy, perform the following checks. The components can be identified as shown in the picture.



5.1 Checking the line voltage, fuses and LED's

5.1.1 Checking the line voltage

Measure the supply voltage at site using the digital Multimeter.
Ensure that the supply conditions

- Voltage – Should be between 99-121V for 110 V line connection, or 170-264V for 230 V line connection.
- Frequency – Should be 50 or 60 Hz
- Mains Resistance – Should be 0.36Ω max. for 99-121V or 1.5Ω max for 170-265V

Switch the Unit ON

NOTICE	If the Unit can not be switched ON Check Supply at Socket. Check Continuity of mains cable with the Plug pins. Check Over Current Protective devices (Fuse Link) U1 & U2.

Switch the Unit OFF.

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5.1.2 Checking the fuses

Open the front cover of the control unit.

Loosen the Fuse carrier, which are mounted on the base of the control unit and check the continuity of fuse link. If fuse link has responded for over current replace the Fuse Link.

5.1.2.1 Fuses on Transformer Plate

Identification	Rating	Purpose
U1	16 A Delayed	Mains Fuse
U2	16 A Delayed	Mains Fuse
U3	6A Delayed, Glass cartridge	Motor Supply
U4	6A Delayed, Glass cartridge	Motor Supply
U5	6A Delayed, Glass cartridge	Motor Supply
U6	6A Delayed, Glass cartridge	Charging resistor to capacitor bank
U7	6A Delayed, Glass cartridge	SMPS supply SMPS 1 & 2
U8	6A Delayed, Glass cartridge	SMPS supply D982 & D985

Note: All Fuses are rated for 250V

5.1.2.2 Fuses on D506

Identification	Rating	Purpose
F1	250 mA Delayed, Glass Cartridge	T1 transformer primary
F2	630 mA Delayed, Glass Cartridge	240/264 V AC Supply
F3	630 mA Delayed, Glass Cartridge	24 V for K3, K4, K5 & K6 relays
F5	4 A Delayed, Glass Cartridge	Filament Circuit

Note: All Fuses are rated for 250V

5.1.2.3 Fuses on D508

Identification	Rating	Purpose
F2	100 mA Delayed, Glass Cartridge	Collimator power supply

Note: All Fuses are rated for 250V

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5.1.3 Checking the LED's

Switch the Unit ON.

After the initialisation, the default data 60 kV and 10 mAs are displayed at first time switch ON or last stored kV & mAs value.

Check for the following LED's

Mode	PCB	LED	Purpose
Standby Mode	D 506	V3	Mains ON
		V9	Mains ON
		V12	24V for relay
		V25	Filament power supply 15 / 24 V
	D508	V11	5V for collimator
Preparation Mode	D915	V22	Preparation ON
Exposure Mode	D915	V23	Exposure ON
Error	D915	V24	Error Indication

5.2 Checking the Control Voltages

When the unit is ON, relays K2 on D506 is ON.

SMPS placed in the Inverter module gets supply, Measure the voltages DC at X15 connector of D915 PCB.

Pin no.	Signal name	Input/output w.r.t. D915	Max. Permissible voltage/current
1	Dgnd	Input	0 V
2	NC	NC	-
3	Dgnd	Input	0 V
4	DC supply	Input	+5 V
5	DC supply	Input	+15 V
6	Agnd	Input	0 V
7	DC supply	Input	-15 V

-nc- = No Connection

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5.2.1 Checking the Line voltage display.

Depending on the input Line voltage 7-segment display on Radiography and memory interface D507 PCB will display line voltage when exposure release switch is pressed in the radiography mode for first 2 sec. The voltage is displayed and if it is not within 2 % tolerance, then change the pot P1 on the D506 PCB.

After switching on the unit, line voltage is monitored after 7 sec. And thereafter at every 5 sec it is polled and displayed in preparation mode with alternative to kV and mAs display. During the preparation and radiography time line voltage is not monitored.

Before changing the pot P1 on D506 release the exposure switch completely and after adjusting the pot wait for 10 sec to get exact changed reading on display.

5.2.2 Checking the Intermediate circuit voltage

Depending on the supply voltage, a value between 250 to 350Vdc must be measured with the Digital Multimeter on Capacitors on the inverter module.

5.3 Checking for Exposure parameters

5.3.1 Checking the Main inverter frequency

- Turn the Unit OFF.
- Short the ST link on the D915
- Switch on the unit
- The display will be Pr 1 on the radiography display field
- Press the kV increment key to reach Pr 7
- Press the DL_SERV key on the D507 PCB
- The display will be Adj F
- Connect oscilloscope on D915.TP.REG and D915.TP.GND.
- Press the exposure release switch.
- The display will be F on
- Measure the REG frequency at the REG TP on D915.
- It should be 9.2 $\pm$ 0.3 kHz
- If not tune P4 to set REG within the above range.
- Press DL_SERV again
- Switch off the unit
- Remove ST link from the D915.

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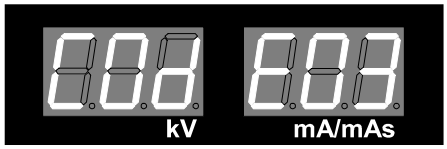
5.3.2 Checking the Filament frequency

- Turn the Unit OFF.
- Open X11 connector on D915.
- Connect oscilloscope to D915.TP.CAL
- Turn the unit ON unit displays



- Measure the CAL frequency at the CAL TP on D915.
- It should be within 1.25 to 1.5kHz
- If not tune P3 to set CAL within the above range.
- Switch off the unit
- Connect back X10 connector.

5.3.3 Filament current measurement

- Turn the Unit OFF.
- Connect oscilloscope to D915.TP.IH
- Turn the Unit ON.
- After approx. 3 seconds the Stand-by filament current starts & should be 1.5V ± 0.2V
- Select radiography mode
- Select the exposure release switch for 1 sec to enter into preparation.
- Observe the change in voltage level from 1.5 V ± 0.2V to Preheat value 2.8V ± 0.3 V.

Note: Preheat value is parameter (kV & mAs) specific. Just observe the change in level on preheating step.

5.3.4 Checking of kV and mAs values

5.3.4.1 Checking the high voltage kVsoll and kVist

- Connect oscilloscope to D915.TP.KVS & D915.TP.KV
- Turn the unit ON.
- Select radiography mode.
- Set parameters of 60kV 10mAs
- Trigger an exposure.

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- Observe the voltage on C.R.O with the scale corresponding to 1V= 20 kV at kVist, 1V= 30kV at kVsoll.
- The readings should be within ±5% of the selected value.
- Repeat the measurement with the following parameters
    1. 40kV 10mAs
    2. 81kV 16mAs
    3. 100kV 20mAs

5.3.4.2 Checking the tube current

- Connect oscilloscope to D915.TP.JRS & D915.TP.JR
- Turn the unit ON.
- Select radiography mode.
- Set parameters of 60kV 10mAs
- Trigger an exposure.
- Observe the voltage on C.R.O with the scale corresponding to 1V= 20mA.
- The readings should be within ±5% of the value as per the exposure chart.

5.3.4.3 Checking the kV and tube current

- Connect oscilloscope to D915.TP.KV & D915.TP.JR
- Turn the unit ON.
- Select radiography mode
- Set any parameter combination
- Trigger an exposure.
- Observe the voltage on CRO (1V=20kV & 1V = 20mA) for selected kV & mAs.
- The readings should be

5.3.4.4 Checking the mAs values

- Turn the Unit OFF.
- Remove the Shorting Link “mAs +/-” on D506 PCB banana sockets.
- Connect mAs meter to “mAs +/ mAs-” on D506 PCB.
- Turn the Unit ON.
- Trigger an exposure with 40kV 200mAs.
- The mAs reading on the meter should be within ± 5% of the selected value.
- Repeat the measurement with the following parameters.
- 52kV, 64mAs
- 100kV, 2.5mAs

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- The mAs values should be within ±5% for values > 20 mAs and ±10 % for mAs ≤ 20 mAs.
- If the values are not within the above range, tune P1 on D915 to adjust the mAs values.

5.4 Automatic Dosage Regulation

Automatic dose regulation constantly adapts the X-ray radiation to the thickness and density of the irradiated object in an optimum manner. Through the fast detection of dose rate, an optimum picture Quality is obtained for a thick object with a minimum fluoroscopy time. ADR is possible in two different mode of operation 1) Anti-isowatt and 2) Contrast mode. Fluoroscopy mode is selectable from the control panel (By default Anti-isowatt mode is selected).

When contrast mode is selected the mA for that particular is increased hence the contrast of the image when compared to anti-isowatt mode. Check for the same.

The detection circle of the ABC signal is 1/3rd the diameter size of the circle blanking with same centre as that of the image. The pixel shades over the entire circle are averaged to generate a signal proportional to the brightness / contrast level. This ABC signal varies from –8V corresponding to total darkness and +8.0 V DC, to bright image.
This signal is sent to PCB D508, which generates a proportional signal to be applied as the Automatic Dose Regulation (ADR) signal to the analog port of microcontroller in PCB D915. The circuit on the PCB D508 consists of level shifter followed by unity gain buffer in inverting mode-using TLO82. The output of this circuit is a signal proportional to the darkness / brightness level. The magnitude varies from 0 to 5V DC.
To Adjust the PCB, the following potentiometers are to be tuned

Remove all cable connections coming to the PCB D 508.
Remove IC J15: TL 082, which is mounted on the socket.
Connect a Multimeter between test point ABC and J15 socket pin 2.
Adjust resistance: 126K using VR5
Resistance between test point 0VA and J15 socket pin 6
Adjust resistance: 48.33K using VR2

Resistance between test point J15 socket pin 6 and pin7

Adjust resistance: 49.65 K using VR1.

5.4.1 ADR Stop Mode (Manual)

In ADR Stop Mode, adjustment of kV and mA is possible Manually. In cases where small adjustments of contrast is required to view the finer details of the image, the kV and mA values can be adjusted by pressing the ADR stop switch.

When a metallic object comes in the X-ray path (e.g. a marker) or when the deviation in object density is large (e.g. Repositioning a fracture), it may be required to fix the kV Values earlier regulated in the automatic mode. Selection of Contrast mode is not possible in the ADR stop mode.

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5.5 Replacing the single tank

To replace the single tank, remove it from the C arm as follows:

- Bring the C-arm in the horizontal position such that the axis of the x-ray tube and II are in the horizontal plane. Lock the brake of the trag arm so that the C arm does not move.
- Remove the side cover and top cover by removing the ornamental screw.
- Disconnect the Single Tank connections by removing connections from D502 and the earthing point.
- Remove the collimator and temperature sensor connections.
- Loosen the Socket headed screw used to anchor the single tank to the C-arm using Allen key.
- Lift the single tank off vertically and place it on a soft base.
- Detach the collimator by loosening 4x alignment studs
- Mount the new single tank with the collimator
- Make the connections in D502, collimator and temperature sensor connections.
- Check alignment of X-ray beam with II and adjust if necessary.

5.5.1 Replacing the collimator

In case of any damage to collimator the collimator has to be replaced completely.

- Loosen the connector on the collimator cable and disconnect it.
- Remove Temp. Sensor wires.
- Remove collimator by loosening alignment studs.
- Fix the new collimator; fasten it with 4x alignment studs.
- Connect the Temp. Sensor cables & collimator cable connector.
- Align the beam to the centre of the Image intensifier by centring the collimator with respect to the II using the four alignment studs.

5.5.2 Aligning the X-ray field to Image Intensifier

Fix the collimator assembly on the X-ray tube head and close collimator fully using the collimator close switch on the control panel so that the small circular image will be seen on the monitor during fluoroscopy. Adjust the image in the centre of the II by using the alignment stud provided on the collimator plate.

The iris of the circular collimator can be adjusted using the potentiometer VR4 provided on the D508 PCB. The maximum allowable field size is the same as the field size of the Image intensifier, which can be observed on the monitor. Thus the Single Tank and Collimator assembly is centred.

When radiographs are to be taken, the circular collimator should open as soon as the control switches from Fluoroscopy mode to radiography mode. This field to be

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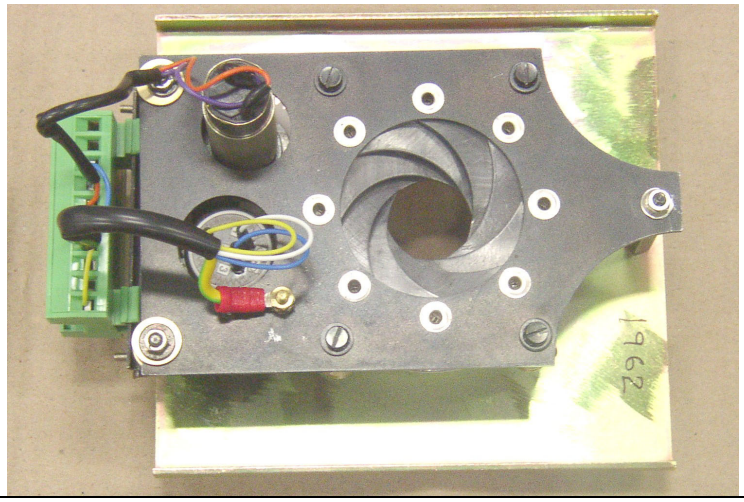
adjusted for maximum cassette size (10” x 12“) by using VR3 which results in a larger radiation field during radiography.



CAUTION	The calibration of the Unit is Specific to the Single Tank. Re-calibrate the unit when the single tank is replaced.

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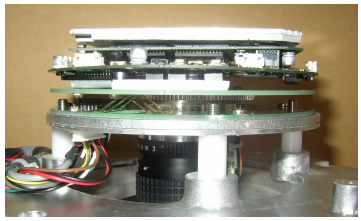
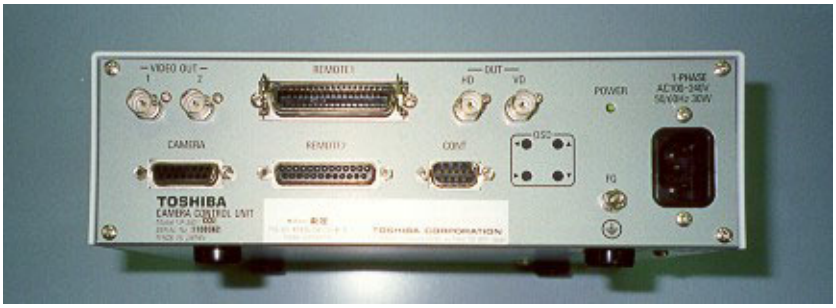
6 CCU AND CAMERA CONTROL

6.1 INTRODUCTION

The TV camera has the following features
A recursive filter circuit reduces X-ray quantum noise and a motion detection function provides sharp images of quick-moving objects while reducing noise. Horizontal/vertical image reversal functions The LIH (Last Image Hold) function of image freeze. In addition to the image freeze function, the TV camera is provided with 8-frame memory. This function permits a memory image and a live image to be switched for display on TV monitor. The playback image from one of the four-frame memories can be output to a dedicated output terminal for continuous observation on another monitor. These images can be compared against live images, freeze images, and playback images
Image rotation function is incorporated using the slip ring mechanism in which motor rotates the interior part of camera head. ABC (Automatic Brightness Control) signal is generated in camera to control the output X-ray.
The camera system comprises of :
(1) Camera Head including lens .



(2) Camera Control Unit (CCU)



6.2 RATINGS

TV SYSTEM	CCIR 15.625kHz(H), 50 Hz(V) (625lines/25frames)
CCD	½ inch format, interline transfer
Effective number of pixels	CCIR 752 (H) x 582 (V)
Sync. method	Internal sync.

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Aspect ratio	4:3
Video output	VS 1.0 V / 75 Ohm BNC connection, 2 routes
Lens mount	C mount
Input power	Single-phase, 100 - 240V, 50 or 60Hz
Power consumption	30 W approx.

Environmental

	Temperature	Humidity	Air pressure
Operation	+10 to +40 °C	30-75% RH max.	70 – 106 kPa (no condensation)
Storage & Transportation	-15 to 45 °C	95% RH max.	76 – 106 kPa (no condensation)

6.3 CONNECTION TERMINALS OF CAMERA CONTROL UNIT (CCU)

CAMERA (D-sub15)	Connected to the camera head with the camera cable.
VIDEO OUT 1 and 2 (BNC)	Digital Video signal: LIH image, Memory image. Monitor is connected to this terminal.
REMOTE CONTROL 1 [36-pin(D57;DDK)]	Input/output of the one signal group for external control of camera.
REMOTE CONTROL 2 (D-sub25)	Input/output of the other signal group for external control of camera.
HD OUT (BNC)	Horizontal drive pulse output for external devices
VD OUT (BNC)	Vertical drive pulse output for external devices
AC100-240V	AC power input.
FG	Grounding terminal.
CONT (D-sub9)	For camera control with RS232c.

6.4 PERFORMANCES /FUNCTIONS

CCD operation method	Frame accumulation
Resolution	(CCIR) 560 TV lines (H) 520 lines (V) or more for frame accumulation
S/N ratio	55dB or more (under Normal gain, AP;OFF, γ ;1, Using 4.2 MHz low pass filter)
Frequency response	0 to 8 MHz (-3dB)
Aperture correct. (AP)	Front & rear edge emphasis for both H&V. AP ON/OFF & emphasis level are selectable

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	internally.
AGC	Keeps video signal increased to +6 or 12 dB compared With the standard level when AGC ON. AGC ON/OFF & AGC level is set internally. The video signal for sampling is detected within the area of a square at the image center (AREA detection) or in two small areas located on the image (DIVISION detection).The area size of the AREA detection can be adjusted to 10, 20, 30, 40 & 50% of the image height internally. The area is displayed on the monitor when adjusting the size. The area size of the DIVISION detection is fixed. The signal detection in case of the AREA detection is of peak detection or average detection selectable internally. The signal detection in case of the DIVISION detection is of weighted average detection.
Gamma (r)	0.45 & normal gain.
Black / white reversal	Outputs LIVE image in negative when the function is ON or during external ON signal input when the function is in EXT mode. The function ON/Ext is selectable internally.
Shading correction	SAWtooth and PARAbolic for both H and V. Correctable more than + 0.2V under γ ; 0.45 and normal gain.
Circle blanking	Diameter is adjustable from 90% of useful image screen height to useful image screen width (133% of useful image screen height).
Noise reduction(NR)	Recursive filter with motion detection for reduction of X-ray quantum noise.
K constant	Any one of 4 preset constants with independent motion detection level can be selected by external control. The factory preset constants are 2,4,8 & 16 with motion detection level of Medium respectively. In case no external selection is input, the other internally preset constant works. The factory preset constant for this is 3 with motion detection levels of Medium also. These % constants can be changed internally to the desired values chosen from 1,1.5,2,3,4,8,10,12,14,16,24 and 32 with motion detection level selected from 4 steps respectively.

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Motion detection level	Low, Medium, High and No motion detection.
Image reversal	Horizontal and vertical : Internal switch or external control
Image freeze (LIH)	Continuous playback of the video signal in frame memory when freeze signal input is set to ON until freeze signal is OFF. Then outputs freeze image (external control). LIH function can be switched OFF (internal switch or external control).
Frame memory	4 frames : Selection, recording, and playback are Controlled externally. The playback signal in the selected memory is output to the dedicated output terminal (OP.MEM OUT).
ABC voltage output	DC voltage corresponding to the video signal level for controlling X-ray exposure. ABC gain(output voltage change corresponding to a certain change in video signal amplitude) & DDC offset of ABC can be adjusted internally. Adjustable range is –8 to 8V including offset and the output impedance is 75ohms. The way of sampling signal detection is the same that of the AGC.
Character display	Displays the identification character of video signal output on the monitor and confirmation for recording into memory. VIDEO OUT 1 and 2; Identification character for outputs: "LIH", “MEM” for the standard memory playback image and "MEM1" to MEM4" according to the selected memory They are always displayed at the upper left. Confirmation of recording: Changes to "REC" during recording into the standard memory, and to "REC 1” to "REC4" during recording into optional memory for one second.
Image rotation:	Rotation of 360 deg possible in both CW and CCW by external control. Approx. 10 seconds required for 360 deg rotation. Returns to the O deg position at power ON
Pulse output:	HD and VD, approximately 5 V, negative polarity, low Output. Impedance: 75ohms.

Image reversal function

This function is performed by reading images from frame memory vertically and /or horizontally in the opposite direction to that during recording.

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LIH function
When the LIH ON (X-ray OFF) signal is input, writing of the video signal into frame memory is halted and the signal in the memory is played back continuously until the LIH OFF (X-ray ON) arrives to obtain static images. It is possible to switch between frame read-out and field read-out. When the LIH is OFF, the memory image is updated and the LIH image is cleared.

Frame storage function
Frame memory in addition to memory for LIH is used for this function. This function allows one frame of the video signal to be recorded at any timing and then to be played back continually to obtain a static image. Unlike the LIH, images in this memory can be accessed as many times as required (images are output to VIDEO OUT 1 or 2 by the output switch).

Recursive filter
This reduces X-ray quantum noise in the video signal and performs summed averaging of video signals along the time axis. The reduction coefficient can be switched among four steps, including OFF, using CONT BOARD switch S2 (INT VAL) and by remote control. The motion detection function is not provided.

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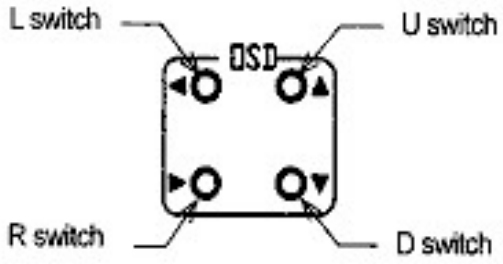
6.5 ADJUSTMENTS & EXTERNAL CONTROL

1. Introduction

Settings/adjustments of the VP-34017 camera series are performed with OSD (On Screen Display). The procedures for them are described in this manual.

2. OSD control switch

OSD are controlled by four push switches located on the panel of the camera control unit(CCU).



3. Function of control switch

U (up) switch: Lets the cursor move upward.

D (down) switch: Lets the cursor move downward.

R (right) switch: (1) Starts the main menu OSD(SETUP MAIN) when pushed together with L switch for more than about 2 seconds.
(2) Starts the OSD of the item selected by the cursor.
(3) Changes values or status of the selected item on the OSD.
(4) Performs SAVE, RESET and INITIALIZE when pushed together with L switch.
(5) Closes the main menu OSD when the cursor is on EXIT.
(6) Lets the OSD go back to the main menu OSD when the cursor is on RET

L (left) switch: (1) Starts the main menu OSD when pushed together with R switch for more than about 2 seconds.
(2) Changes values or status of the selected item on the OSD.
(3) Performs SAVE, RESET and INITIALIZE when pushed together with R switch.

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4. Operation

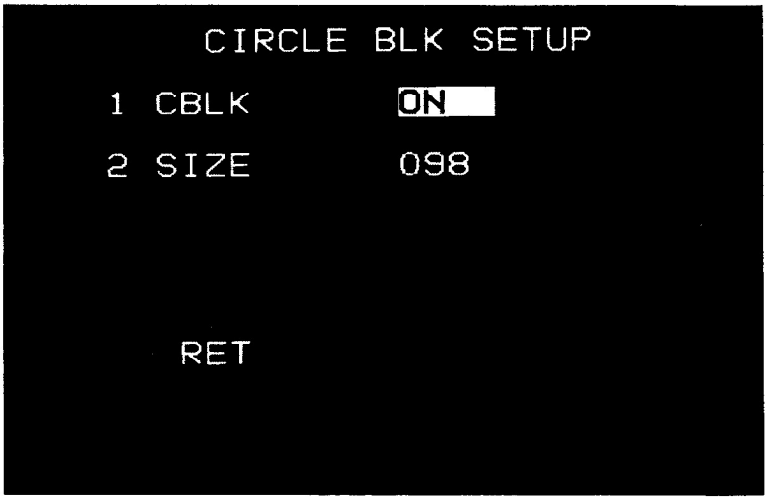
4.1 Starting OSD

Pushing L and R switch simultaneously for more than about 2 seconds starts the main menu OSD indicating the items for adjustment or setting.

OSD of main menu

The rectangle part inverted in black and white is the cursor.
The target item is selected by locating the cursor on the item by U or D switch.
Pushing R switch fixes the selection and starts the OSD of the item (Refer to 4.2).
Pushing R switch with the cursor on EXIT terminates the menu OSD.

4.2 Setting and Adjustment on each OSD



Example of OSD for setting and adjustment

Items to be adjusted or set are listed on the left part and the values or statuses to be selected for the item are displayed on the right part of the OSD. U or D switch selects the target item

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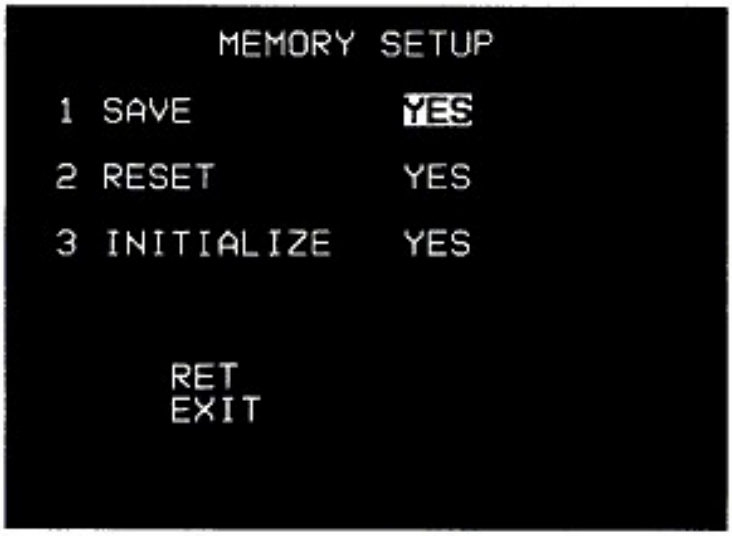
and R or L switch changes numerical values or statuses of the item. The value or status with the cursor on it is selected.
In case of changing numerical value, the value changes one step by one push of R or L switch but it changes in succession when the switch is pressed for more than about 2 seconds.
OSD goes back to the main menu OSD by pressing R switch with the cursor on RET after the setting or adjustment.

4.3 Memory control

The OSD to control the memory for the adjusted data appears by selecting MEMORY by U or D switch and pressing R switch after the selection on the main menu OSD.



OSD for memory control

Pressing R and L switch simultaneously for more than about 2 seconds after placing the cursor on YES of each item performs the action for the selected item. "COMPLETED" appears for a while after completion of the action. (Refer to section 5. about the each item.)
Pressing R switch after selecting RET let the OSD go back to the main menu OSD.
Pressing R switch after selecting EXT let the OSD close.

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6.6 OSD Parameters settings

Items for setting/adjustment of the camera by OSD

Menu OSD		OSD for setting		Valuable	Content of Setting/Adjustment
No.	Menu Item	No.	Setting Item		
1	CBLK	1	CBLK	ON/OFF	ON or OFF of the circle blanking
		2	SIZE	90-133	Adjustment of the circle blanking
2	SHADING	1	SHADING	ON/OFF	ON or OFF of the shading correction
		2	H PARA	0-31	Adjustment of the correction of the horizontal PARA shading
		3	H SAW	0-31	Adjustment of the correction of the horizontal SAW shading
		4	V PARA	0-31	Adjustment of the correction of vertical the PARA shading
		5	V SAW	0-31	Adjustment of the correction of the horizontal SAW shading
3	EXPOSE	1	MODE	AREA/DIV	Selection of the signal extraction method for the ABC and AGC
		2	AREA	1,2,3,4,5	Adjustment of the area of the square in the AREA mode
		3	SENSING	PEAK/AVE	Selection of the detection method in the AREA mode
4	ABC	1	GAIN	0-31	Adjustment of the gain of the ABC circuit
		2	OFFSET	0-31	Adjustment of the offset voltage of the ABC output
		3			
		4			
5	GAMMA	1	GAMMA	1/0.6/0.45/0.4	Selection of the γ (gamma) correction curve
6	GAIN	1	GAIN NOR	0-12	Adjustment of the gain of the GAIN NOR mode
		2	HIGAIN	ON/EXT	Selection of ON or EXT(external control) of the HIGAIN mode
		3	HG LEVEL	6dB/12dB	Gain selection in HIGAIN mode
		4	AGC	OFF/6dB/12dB	Selection of AGC ON or OFF and the gain in case of AGC ON
7	AP	1	APERTURE	ON/OFF	ON or OFF of the aperture correction
		2	H LEVEL	0-255	Adjustment of the horizontal edge enhancement
		3	V LEVEL	0-255	Adjustment of the vertical edge enhancement
8	CCD DRV	1	SHUT	ON/EXT	Selection of ON or EXT(external control) of the CCD shutter
		2	SHUT SP	60(50),125(120),250,500,1000,2000,4000, 8000,10000 (); for the PAL system	Selection of the shutter speed of the CCD
		3	READ OUT	FRAME/FIELD	Selection of the FRAME or FIELD read-out of the CCD
9	IRIS	1	IRIS NOR	0-255	Adjustment of the iris control voltage of the IRIS NOR mode
10	VID CONT	1	H INVERT	ON/OFF	Image inversion in H direction. Re-inversion by external control
		2	V INVERT	ON/OFF	Image inversion in V direction. Re-inversion by external control
		3	LIH POL	POS/NEG	Selection of the logic polarity to adapt to the external LIH signal
		4	CHARA	OFF/EXT	Selection of OFF or EXT(external control) of character display
		5	V NEG	ON/EXT	Selection of ON or EXT(external control) of neg. image output
		6	CONT PS	INT/EXT	Selection of the power source for the circuit of REMOTE 1

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Menu OSD		OSD for setting		Valuable	Content of Setting/Adjustment
No.	Menu Item	No.	Setting Item		
11	DNR	1	DNR0 K=	1,1.5,2,3,4,8,10,12,14,16,24,32	Selection of the noise reduction factor for the DNR0
			MOTION	OFF/P1/P2/P3	Setting of the motion detection for theDNR0
		2	DNR1 K=	1,1.5,2,3,4,8,10,12,14,16,24,32	Selection of the noise reduction factor for the DNR1
			MOTION	OFF/P1/P2/P3	Setting of the motion detection for the DNR1
		3	DNR2 K=	1,1.5,2,3,4,8,10,12,14,16,24,32	Selection of the noise reduction factor for the DNR2
			MOTION	OFF/P1/P2/P3	Setting of the motion detection for the DNR2
		4	DNR3 K=	1,1.5,2,3,4,8,10,12,14,16,24,32	Selection of the noise reduction factor for the DNR3
			MOTION	OFF/P1/P2/P3	Setting of the motion detection for the DNR3
		5	DNR4 K=	1,1.5,2,3,4,8,10,12,14,16,24,32	Selection of the noise reduction factor for the DNR4
			MOTION	OFF/P1/P2/P3	Setting of the motion detection for theDNR4
12	LINK	1	LINK INPUT	CAM/CCU	Selection of the destination for the I.I. mode change signal input
		2	PS SEL	PS1/PS2/PS3	Selection of the I.I. power supply
		3	GAIN LINK	ON/OFF	ON or OFF of the camera gain control linking to I.I. mode change
		4	GAIN MAG1	0-12	Adjustment of the camera gain for the GAIN MAG1
		5	GAIN MAG2	0-12	Adjustment of the camera gain for the GAIN MAG2
		6	IRIS LINK	OFF/INT/EXT	ON or OFF of the lens iris control linking to I.I. mode change
		7	IRIS MAG1	0-255	Adjustment of the iris control voltage for the IRIS MAG1
		8	IRIS MAG2	0-255	Adjustment of the iris control voltage for the IRIS MAG2
		9	SHAD LINK	ON/OFF	ON or OFF of the shading correction linking to I.I. mode change
13	ROTATION	1	CENTER ADJ	0-255	Adjustment of the base position of the image rotation
14	INFO	1	SOFTWARE	(Ver. * * * *)	The version number of the camera control software installed
		2	SER No.	(* * * * * *)	The serial number of the camera
		3	ROTATION	(ENABLE/DISABLE)	Description for whether the image rotation is equipped or not
		4	TV MODE	(NTSC/PAL)	The Television standard of the camera
15	MEMORY	1	SAVE	—	Recording the data of current setting into E2PROM inside.
		2	RESET	—	Replacing the data of the current setting by the data in the E2PROM.
		3	INITIALIZE	—	Replacing the data of the current setting by the data of the factory setting recorded in ROM inside

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(2) The items on the OSD and their contents are as follows.

Item of Adjustment	Indication on Menu OSD	Sub-item on each OSD	Content
Circle blanking	CBLK	CBLK	ON or OFF of the circle blanking.
		SIZE	Size value in percentage (90-133) to the useful image height.
Shading correction	SHADING	SHADING	ON or OFF of the correction.
		H PARA	Numerical value (0-31) for degree of compensation.
		H SAW	The same that above.
		V PARA	The same that above.
		V SAW	The same that above.
Video signal detection for AGC/ABC circuit	EXPOSE	MODE	AREA; Signal is detected in a square area at the image center. DIV; Signal is detected by average in two areas on the image.
		AREA	Square size choice in AREA mode (10, 20, 30, 40 and 50% of the image height).
		SENSING	PEAK; Detects the peak value in the area of the AREA detection. AVE; Detects the average value in the area of the AREA detection.
ABC circuit	ABC	GAIN	Numerical value (0-31) for the ABC circuit gain.
		OFFSET	Numerical value (0-31) for offset voltage of the ABC output.
γ correction	GAMMA	GAMMA	Gamma choice from 1/0.6/0.45/0.4
Video gain control	GAIN	GAIN NOR	Adjustment of video circuit gain (0-12dB) of the normal gain mode. The factory setting is 4dB.
		HIGAIN	Selection of High gain mode ON or Externally controlled High gain mode.
		HG LEVEL	Selection of gain increase level in High gain mode from +6dB and +12dB.
		AGC	Selection of AGC operating basis from +6dB or 12dB and AGC OFF.
Aperture correction	APERTURE	APERTURE	ON or OFF of the correction.
		H LEVEL	Numerical value (0-255) for degree of horizontal edge enhancement.
		V LEVEL	Numerical value (0-255) for degree of vertical edge enhancement.
CCD operation	CCD DRV	SHUT	Choice of ON or External control of the shutter mode.
		SHUT SP	Shutter speed choice.
		READ OUT	FRAME or FIELD read-out choice.

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Lens iris control	IRIS	IRIS NOR		Numerical value (0-255) for the control voltage in case linkage to II mode change is OFF or in case the linkage is INT and II mode is Normal.
Image control etc.	VID CONT	H INVERT V INVERT		Selection of ON or OFF of initial inversion of image in H and V. In case of ON, image is inverted in the direction when the camera is turned ON and reverted when inversion signal is input.
		LIH POL		Change of logic polarity (POS/NEG) to correspond to external LIH signal.
		CHARA		Selection of character display OFF/EXT. When EXT, the function is disabled by external signal.
		V NEG		Negative image is output when receiving control signal in EXT mode or regardless of external control signal in ON mode.
		CONT PS		Photo-couplers to isolate noise in external control signals operate with external power supply by setting to EXT. L or R to INT/EXT selection.
Noise reduction	DNR	DNR0	K=	K constant assignment for preset DNR0. K is chosen from 12 steps.
			MOTION	Motion detection level assignment for preset DNR0. Level is chosen from 4 steps (OFF/P1/P2/P3) (P1;low, P2;medium, P3;high)
		DNR1	K=	K constant assignment for preset DNR1 in the same way that of DNR0.
			MOTION	Motion detection level assignment for preset DNR1 in the same way that of DNR0.
		DNR2	K=	K constant assignment for preset DNR2 in the same way that of DNR0.
			MOTION	Motion detection level assignment for preset DNR2 in the same way that of DNR0.
		DNR3	K=	K constant assignment for preset DNR3 in the same way that of DNR0.
			MOTION	Motion detection level assignment for preset DNR3 in the same way that of DNR0.
		DNR4	K=	K constant assignment for preset DNR4 in the same way that of DNR0.
			MOTION	Motion detection level assignment for preset DNR4 in the same way that of DNR0.

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II mode link	LINK	LINK INPUT	These items are set at the factory according to each imaging system. Do not change the settings.
		PS SEL	
		GAIN LINK	ON/OFF setting of the camera gain control linking to II mode change.
		GAIN MAG1	Gain adjustment (0-12dB) in case II mode is Mag1 when GAIN LINK is ON.
		GAIN MAG2	Gain adjustment (0-12dB) in case II mode is Mag2 when GAIN LINK is ON.
		IRIS LINK	Selection of iris control linked to II mode change and iris control voltage source. OFF; Linkage off, voltage adjusted by IRIS NOR INT; see below EXT; linkage off, voltage input to REMOTE2-#10
		IRIS MAG1	Numerical value (0-255) for the iris control voltage in case of II mode Mag1 when IRIS LINK is INT.
		IRIS MAG2	Numerical value (0-255) for the iris control voltage in case of II mode Mag2 when IRIS LINK is INT.
		SHAD LINK	ON/OFF of the shading correction linking to II mode change.
Image rotation	ROTATION	CENTER ADJ	Numerical value (0-255) for the center position to adjust the base position of rotation.
Camera information	INFO	SOFTWARE	These are the fixed data of each camera just for information.
		SER No.	
		ROTATION	
		TV MODE	
Adjusted data management	MEMORY	SAVE	Saves the results of adjustment on EEPROM memory inside. Pressing L and R simultaneously for more than 2 sec with cursor on "YES" performs SAVE.
		RESET	Replaces the results of adjustment with the data formerly memorized (Cancellation of the adjustment). Pressing L and R simultaneously for more than 2 sec with cursor on "YES" performs RESET.
		INITIALIZE	Camera is initialized to the state of the factory adjustment. Pressing L and R simultaneously for more than 2 sec with cursor on "YES" performs INITIALIZE.

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6.7 Pin assignment

Pin assignment of "REMOTE 1" connector
(36-pin(D57,DDK))

SIGNAL	PIN NO.		SIGNAL
OP1	1	19	M1
OP3	2	20	OP2
OPMWR	3	21	OP4
NR1	4	22	LIH(X-RAY)
NR3	5	23	NR2
CG-OFF	6	24	NR4
V_INV	7	25	H_INV
LIVE(RET_LIH)	8	26	H_GAIN
OPMEM	9	27	OP0
M_DET_STILL	10	28	M2
ROTA-R	11	29	ROTA-C
LIH-OFF	12	30	ROTA-L
NEGA	13	31	SHUTTER
ABC GND	14	32	ABC SIG
VD	15	33	VD GND
0 V	16	34	+15V
PULSE	17	35	M_LOCK
GND	18	36	GND

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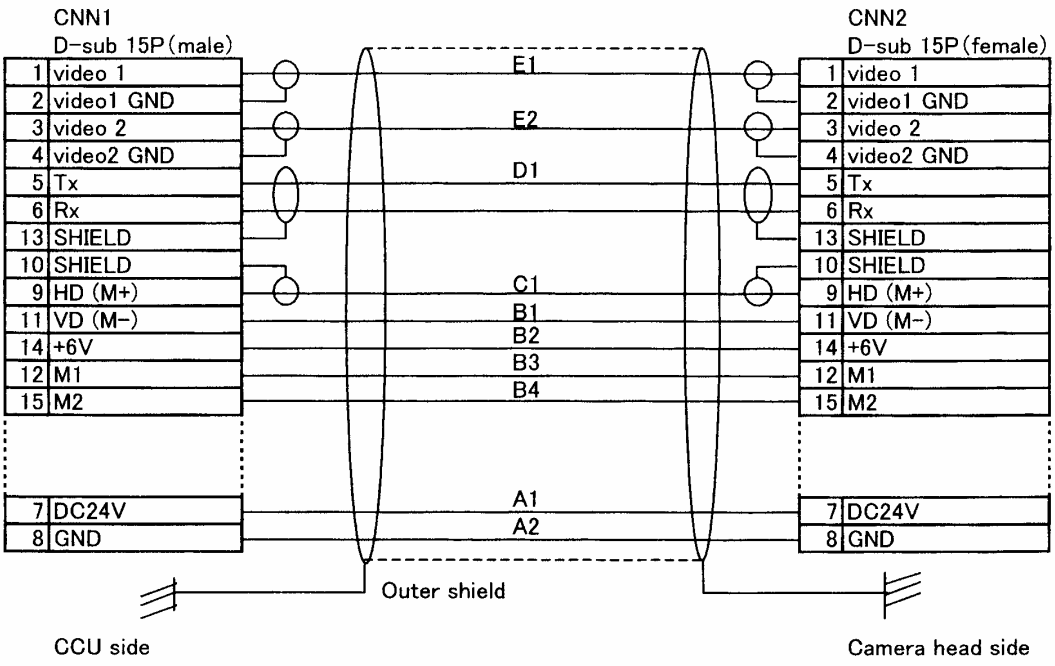
6.7.1 Pin assignment & interfacing details



A 24AWG
B 28AWG
C 24AWG shield
D 28AWG × 2twist shield
E 24AWG shield

6.8 Periodic Checks

No special periodic checks are required. It is recommended that the following checks be performed about once a year to maintain optimal performances.

1 Check the Inspection Sheet supplied with the product to check whether or not the system resolution has decreased compared with that at the time of installation. If the resolution has decreased compared with that at the time of installation, re-adjust the lens focussing.

2 Check the Inspection Sheet to check whether or not the system sensitivity has decreased compared with that at the time of installation. If the sensitivity has decreased, check whether or not there is dust on the CCD surface. If there is dust on the CCD surface, wipe off the dust with a soft cloth. If there is not dust on the CCD surface, the cause is due to the decrease of the II brightness. Compensate for low brightness by widening the lens aperture. However, do not open the aperture wider than F/2, to prevent peripheral resolution from being decreased.

If an image noise is high during image rotation, clean the slip-ring surface with a cotton stick moistened with alcohol. (Be careful not to touch the brushes.) If not improved, remove the "DRIV-ER BOARD" PV;B and slip-ring PWB to clean the brush contact in the same manner. (Be careful not to catch the wire contact.)

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7 Mechanical Checks and adjustments

Service instructions will include periodic servicing or replacement of defective parts, general trouble shooting and rectification of the Multimobil 5C.Some parts such as brakes and bearings may require periodic adjustments for the smooth functioning of the unit.

The service needs are classified under three sections:

1) Parts which needs periodic adjustments
2) Parts which needs servicing or replacements
3) Trouble shooting and rectification

7.1 Parts which needs periodic adjustments

Following are the parts that will need periodic adjustments. The adjustments can be checked in six months or a year depending upon the frequency of use of the machine.

1. Brakes
2. Bearings
3. V-belt
4. Chain
5. Handles

7.1.1 BRAKES

All brakes are adjusted and pinned in the factory upon dispatch of the unit. During the adjustment of the brakes at site, the service engineer has to remove the tubular pin and do the required adjustment and after the adjustment, the tubular pin has to be fixed in. If the same is not done, the adjustments may slip off.

7.1.1.1 Adjustment for the orbital C-Arm movement brake

Procedure for the adjustment of brake

1. Turn the C-arm about its vertical axis to 180° i.e. in this position the Image intensifier should be at the lower level and single tank on the top side. Remove the rubber cap (M10075996) from the Trag arm.
2. Using a spanner of 12-13, tighten the threaded case so that the tension on the spring disc increases. After every half turn of the screw check the brakes.
3. Once the brakes are set, fix the rubber cap back and bring the C-arm back to its original position.

7.1.1.2 Adjustment for the horizontal C-Arm movement brake

1. Remove the protection cover, after removing the handle knob.
2. Remove the tubular pin using a flat punch.
3. Remove both the grub screws M4x8
4. Remove the handle along with the stud by rotating it.

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5. Fix the stud back on to the bush and using a screwdriver tighten the stud until the horizontal movement is properly braked. Note that this is the braked position.
6. Replace the handle knob by rotating it on the threads of the stud. When the handle is tight (i.e. the handle cannot be screwed any more), fix the first grub screw and tighten it to the maximum extend. This is the braked condition. Turn the handle 90°anticlockwise. The brakes will be released. This is the unbraked condition. Fix the second grub screw at this point.
7. Replace the tubular pin with a new one and fit the protection cover.

7.1.1.3 Adjustment for the swivel C-Arm movement brake

1. Remove the false cap by removing the ornamental screw of M4x5.
2. Remove the dowel pin from the handle knob fitted on the left side (right side handle should not be disturbed) using a flat punch.
3. Loosen the grub screw and remove the handle out.
4. You will find a distance bush. Loosen the four grub screws of the distance bush and rotate for tightening the distance bush. Check the movement under braked and unbraked condition. Once the brake is set (i.e. Maximum tight or locked position) fix the grub screws back. Fix the handle and dowel it. Fit the cap.

7.1.1.4 Adjustment for the Angulation C-Arm movement brake

1. Remove the cap complete by pushing the buffer washer back and removing the socket HD screws, M4 X 35, 3nos.
2. Keep the tubes and hardware carefully.
3. Remove the dowel pin using a flat punch.
4. Loosen the grub screw.
5. Now, just keep on tightening the handle until desired tightness/setting is achieved. If required add few more spring disc or spring washers.
6. Once the brakes are set, dowel the brakes and put back the cap complete.

7.1.2 BEARINGS

Following bearings will need periodic adjustments.

1. Floating bearings and delring needle roller cage fitted on the Trag arm.
2. Roller complete and 635ZZ bearing fitted on the Trag arm holder.

7.1.2.1 Adjusting Floating Bearing

For the adjustment of the floating bearing, following are the procedures

1. Remove the cover complete by removing the ornamental screws.
2. Loosen the grub screws after removing the PVC caps, which holds the pins of these bearings, so that the bearings can float.

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3. Now using an Allen key, rotate the eccentric pins of the floating bearings in the clockwise/anticlockwise direction as desired for adjustment. While doing so, keep a watch on the movement of the C-arm, as the bearing should not go too tight.
4. Once the movement is smooth, tighten the grub screws and lock the bearing pins. Also check the balancing of the C-arm after the bearing adjustment.
5. Fit the cover complete back and fix the ornamental screw.

7.1.2.2 Adjustment of Support Bearing

For the adjustment of the supporting bearing, following are the procedures

1. Remove the cover complete by removing the grub screws.
2. Loosen the grub screws, which hold the eccentric pins of these bearings, so that the bearings can rotate.
3. Now, using a screwdriver rotate the pins in the clockwise/anticlockwise as desired for adjustment. See that the bearings come in contact with the C-arm profile. During adjustment of the bearings see that both bearings are maintained at same eccentricity.
4. Once the bearings are adjusted, tighten the grub screws and lock the bearing pins.
5. Fit the cover complete back to in the place.

7.1.3 V-BELT

The V-Belt is used for the transfer of power from the motor pulley to the main pulley. If the tension in the belt is not sufficient or if it is loose, there will be loss of power due to slip, resulting in noisy up-down motion, wobbling of the belt, rubbing sound, jerks etc, which can cause inconvenience to the doctor during operation. Hence the belt has to be maintained in a tight position.

1. Lift the unit from the rear side and place some wooden support below the rear wheels so that there can be a access for tightening the belt.
2. Now, remove the front cover of the unit.
3. Loosen the screws of the motor from bottom side of the trolley base.
4. Pull the motor towards the backside so that the belt is under tension. At this point tighten the screws of the motor.
5. Place the unit back on the floor.

7.1.4 CHAIN

Roll-on chain is used in the steering mechanism. The chain is routed through the sprockets of two rear wheels, two idler sprockets, and the drive shaft. The chain is in two halves and there are two adjustable nuts provided to adjust the tension in the chain.

When the chain is loose, there is a tendency that the chain can slip off from the sprockets, hence proper tension should be maintained in the chain.

For adjusting the tension in the chain, following are the steps

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a) Lift the unit up from the rear side and place a wooden platform below both the rear wheels.
b) Locate the adjustable nuts in the chain.
c) Loosen the check nut (M5) used to lock the movement of the screws.
d) Tighten the adjustable nut in the clockwise/anticlockwise direction as required.
e) Lock the screws with the check nut so that the adjustable nut does not turn.
f) Place the unit on the floor and operate the steering lever to check the movement. The force required to move the steering lever should not be more than 2-3kf

7.2 Parts which needs servicing or replacements

Following are the parts that may need replacement or servicing depending upon the frequency of use.

1. V- Belt
2. Bearings
3. Brake liners

7.2.1 V-Belt

The V-Belt may undergo wear and tear after a period of one year or so depending upon the use of the up-down movement. Hence, the worn out belt may cause troubles such as slip (Causing jerky movement), noise and can also fail (rupture) and make the machine idle.
Hence, it is the responsibility of the service engineer to keep a watch on these activities and change the belt from time to time.

7.2.2 Bearings

Bearings, generally doesn't get worn out under clinical conditions. Only possibility that cannot be ruled out is the wearing out of balls after a period of five to eight years. This may cause noise in the movement and misalignment of movement.
Hence, it is the duty of the service engineer to clean and grease the bearings regularly.

Following bearings can be serviced periodically.

1. Universal bearing.
   This bearing needs periodic greasing or oiling; as this bearing is responsible for your smooth up-down movement .The procedure is as follows.
   1. Open the front cover.
   2. Remove the limit switch holder bracket from bottom.
   3. Now you get a clear access for applying grease or oil. While greasing, rotate the bearing constantly so that every part gets lubricated.
   4. After lubrication fit the switch and put the cover.
2. Roller complete and eccentric bearing of Trag arm holder
   Steps for servicing

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1. Open the cap complete by loosening the ornamental screw.
2. You will find the bearings. First of all pour a few drops of petrol or kerosene on these bearings and clean them thoroughly. This will remove all dust and other inclusion and make the bearing free.
3. Now put a few drop of oil and move the square tube to and fro and make the movement smooth
4. Fix the cap complete back.

3. Floating bearings and supporting bearings of Trag arm.
   1. Remove the cover complete by removing the ornamental screw.
   2. Follow the same procedure as the one used for Trag arm holder.
   3. Apply grease or oil and fix the cover complete.

7.2.3 Brake liners

Brake liners of the brake shoes wear out after a few years of usage, resulting in loss of braking efficiency. In case of such incidence, the brake liners along with the brake shoes need to be replaced.

7.3 Trouble shooting and rectification

Listed below are the general troubles encountered on site and their remedies.

Sr. No.	Troubles	Causes	Remedies
1	Braking inefficiency	Worn out brake liners	1.Adjust the brakes (tighten) 2. Check the liners, if required, replace them
2	C-Arm movement not smooth	Floating bearing mis-aligned	1. Adjust the bearings 2. Check the bearings for noise and lubricate them
3	Wheels making noise	Bearings are dry or Wheel surface worn out	1. Open the wheels and grease them. 2. If the wheels are worn out, replace them.
4	Noisy up down movement	V-belt is loose or worn out. **Or** Universal bearing requires greasing **OR** Noisy operation	1. Tighten the belt or replace the belt depending upon the condition of the belt. 2. Do proper oiling of the bearing. 3. Isolate the motor and check for noise.

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Sr. No.	Troubles	Causes	Remedies
		of motor	Change motor if required
5	C-Arm brakes fail	Tension rod broken **Or** Lever slipped from the brake shoe.	1. Open the Trag arm assembly and fit the new tension rod 2. Open the Trag arm and fix the lever to the brake shoe.

In case of any problems, follow the below mentioned procedure.

- Check whether it is an electrical problem or a mechanical problem.
- The electrical problems can be such as loose contacts, removal of wire from the limit switch or contactor etc.
- If it is a mechanical problem, it could be any one of the above mentioned. In such case trace the problem in the following way.

NOTE: The solutions are listed out in steps for rectifying up down movement of the column. One must follow the procedure and stop at the particular point where he gets the solution or remedy.

1. First of all, lift the unit up and place some wooden blocks below the rear wheels so that there is sufficient access to work from under side.
2. Check whether the V-Belt is in good condition and is not broken.
3. Try to rotate the main pulley manually and see whether it is free and not getting stuck. Power on the motor and give a few jerks. Now try to move the column up and down. See whether you can get a smooth movement. If the movement is fine, you can stop at this stage. The cause of problem could have been some fine rust or dirt particles, which might have got stuck in the spindle threads.
4. If the pulley has got stuck completely and does not move freely, then the tube assembly has to be dismantled. This case only occurs when the limit switch fails and the unit goes to the maximum upper limit or to the minimum lower limit.
5. In case the unit reaches the maximum upper limit, the safety nut locks the spindle and stops any further movement, hence preventing the machine from falling on to the patient. In such case the complete tube and column assembly has to be dismantled and reassembled using new spindle (if required i.e. if the threads are not damaged, the same spindle can be used)
6. In case, the lower limit switch fails, the column moves to the minimum lower limit, the guide hits the bottom stopper, upwards thrust is developed and the universal bearing comes out of the bearing holder, pulling the pulley close to the base frame and the movement gets stuck.

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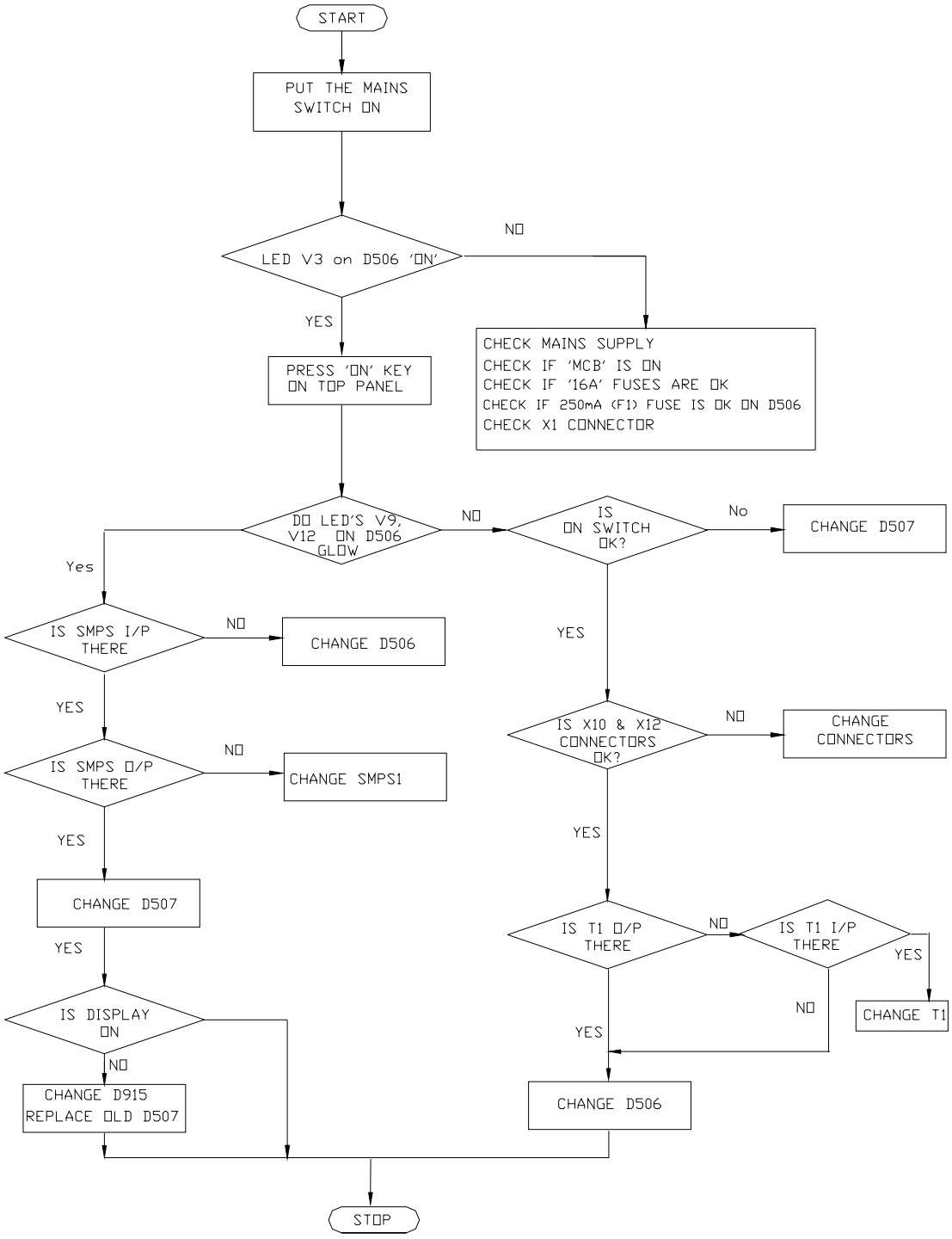
8 Appendix I

8.1 Specific Error Code Handling

8.1.1 Unit not turning ON



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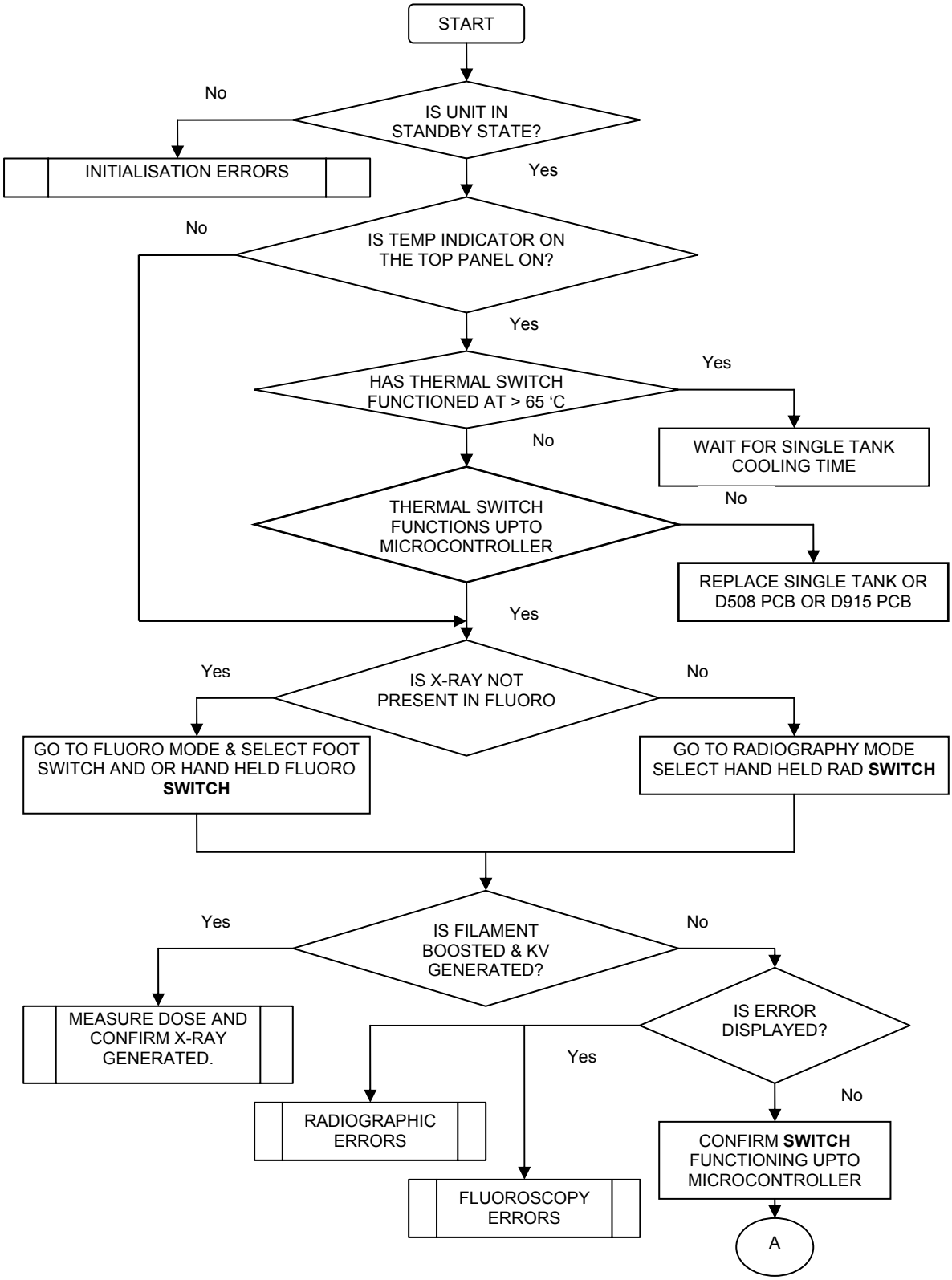
8.1.2 No X-ray



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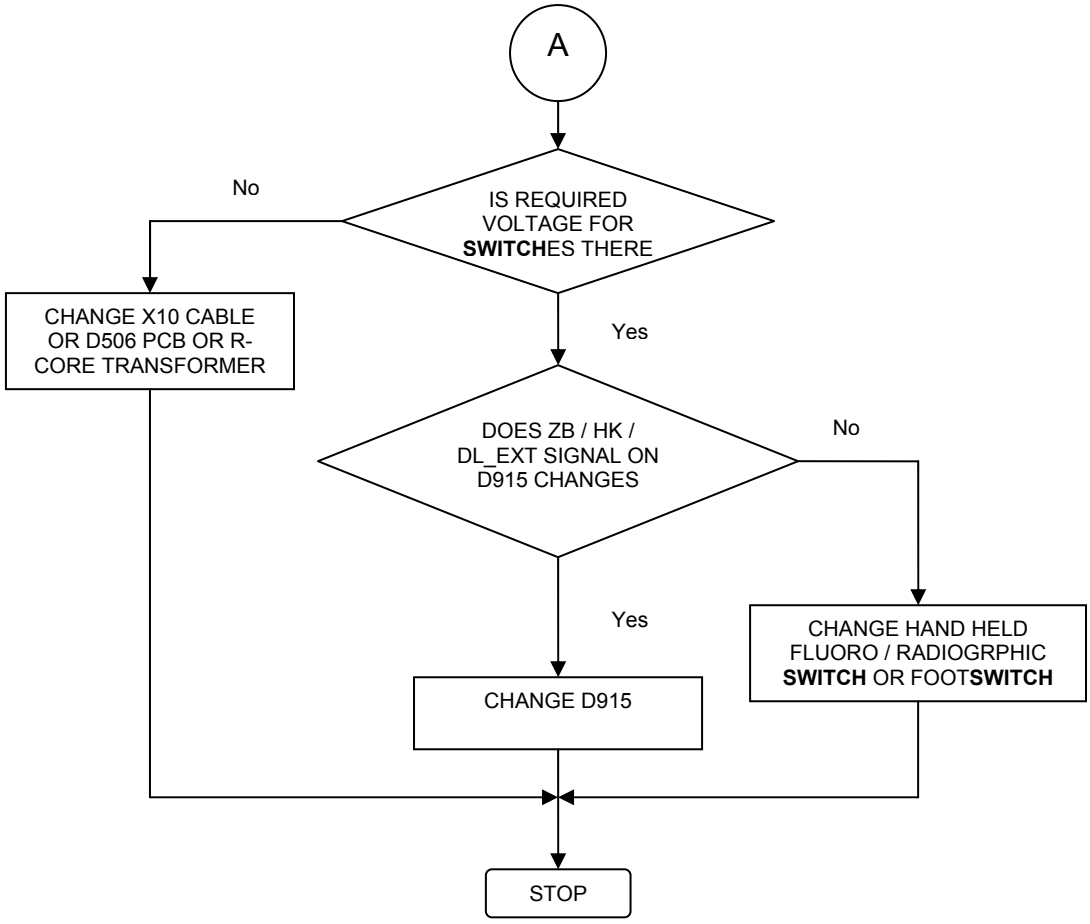
No X-ray Contd….



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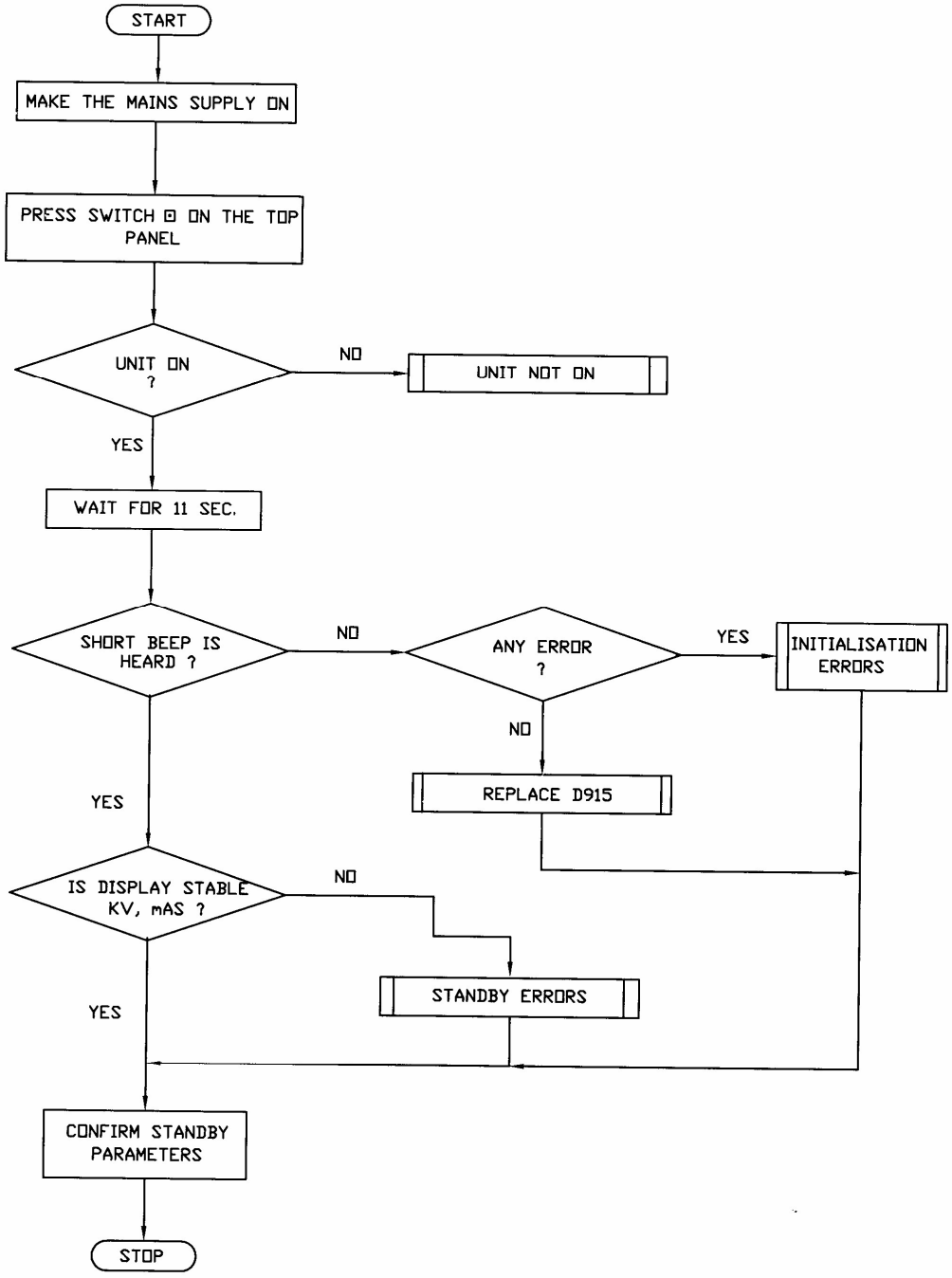
8.1.3 No Standby



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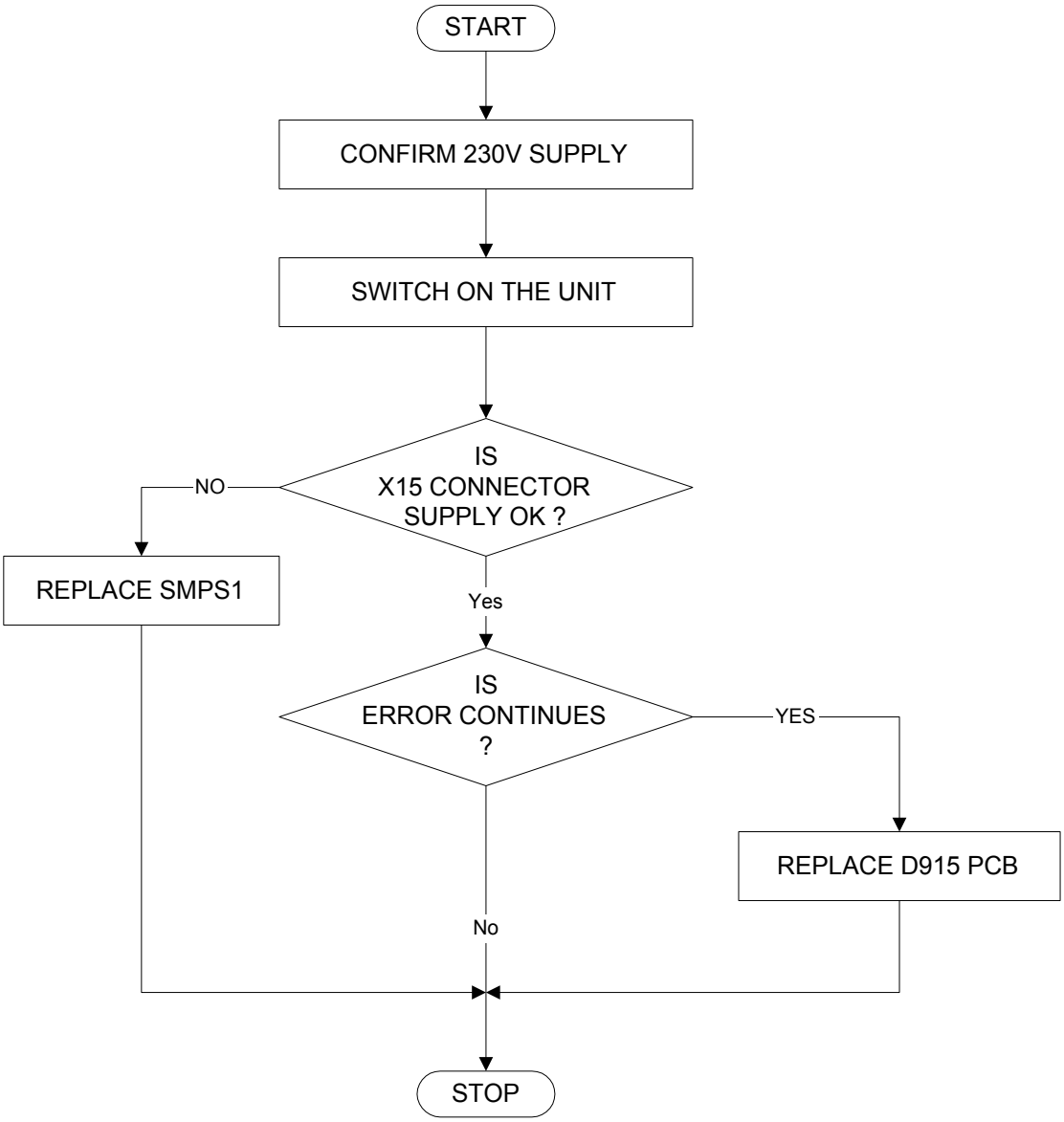
8.2 Initialisation Error codes

8.2.1 CodE 90 (EPROM CHECKSUM FAILURE)

8.2.2 CodE 96 (KV SOLL FAILURE)

8.2.3 CodE 97 (mA FAILURE)

8.2.4 CodE 99 (LAST RESET BY WATCH DOG TIMER)



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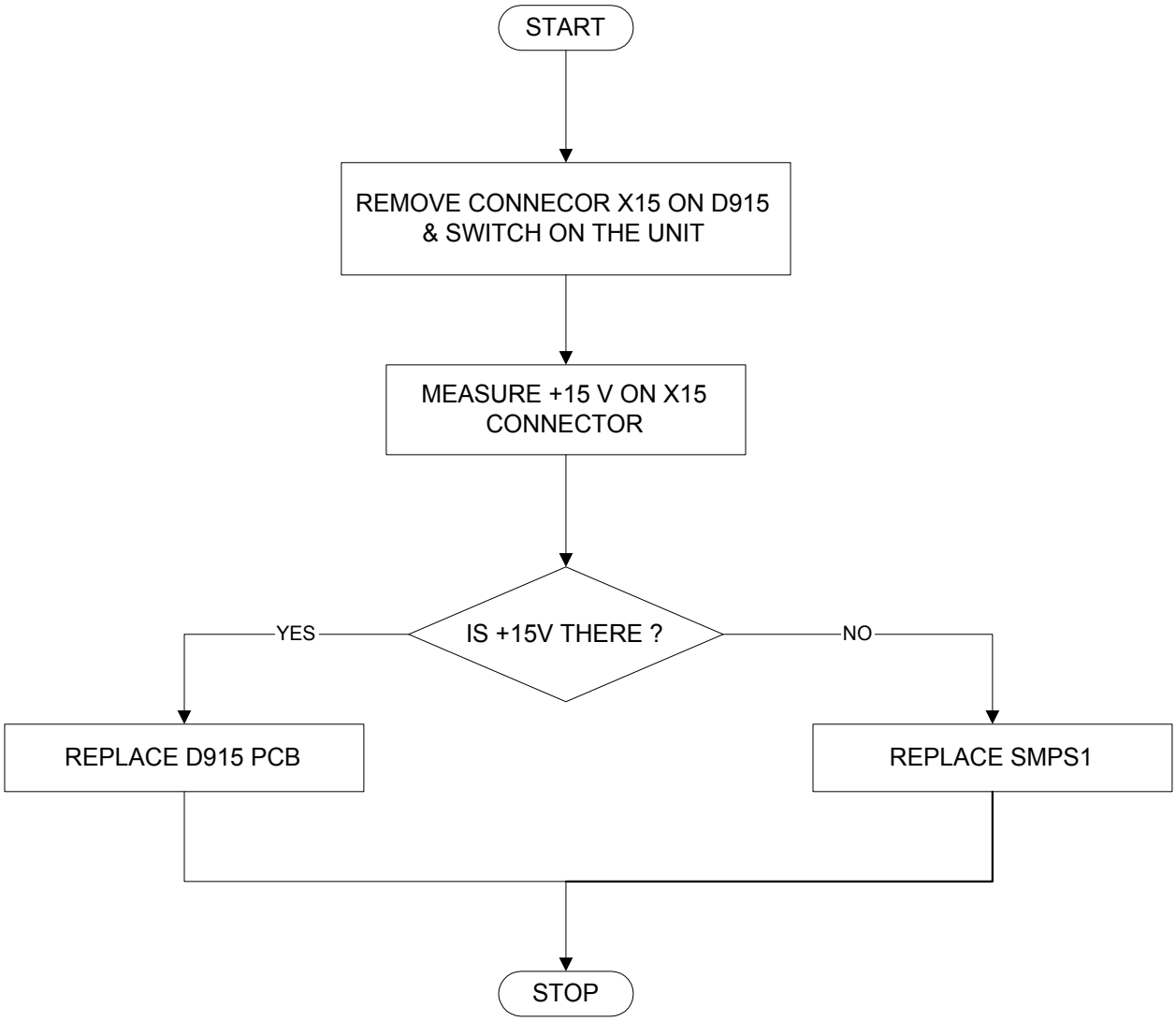
8.3 Standby Error codes

8.3.1 CodE 02 : +15 V Supply Error



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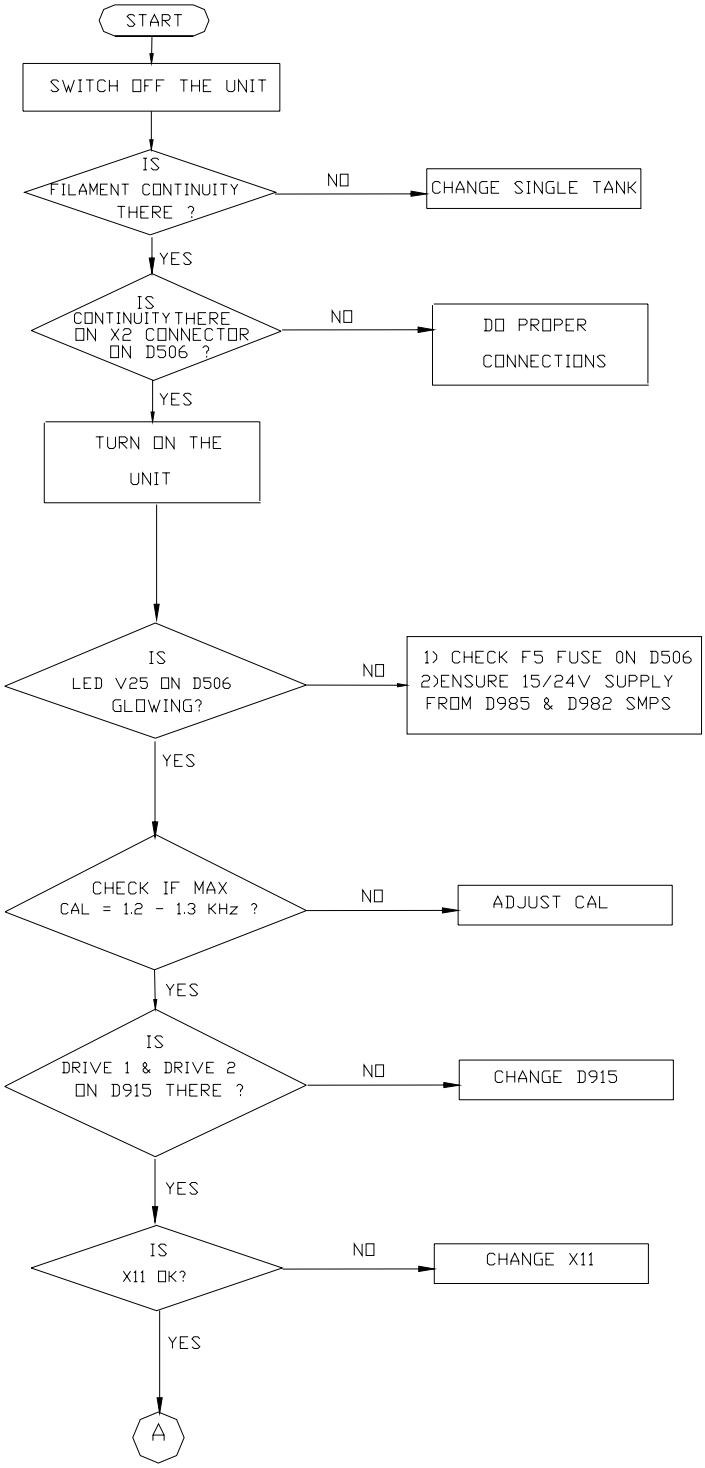
8.3.2 CodE 03 & 04 : Iheiz < Istby & Iheiz > Istby



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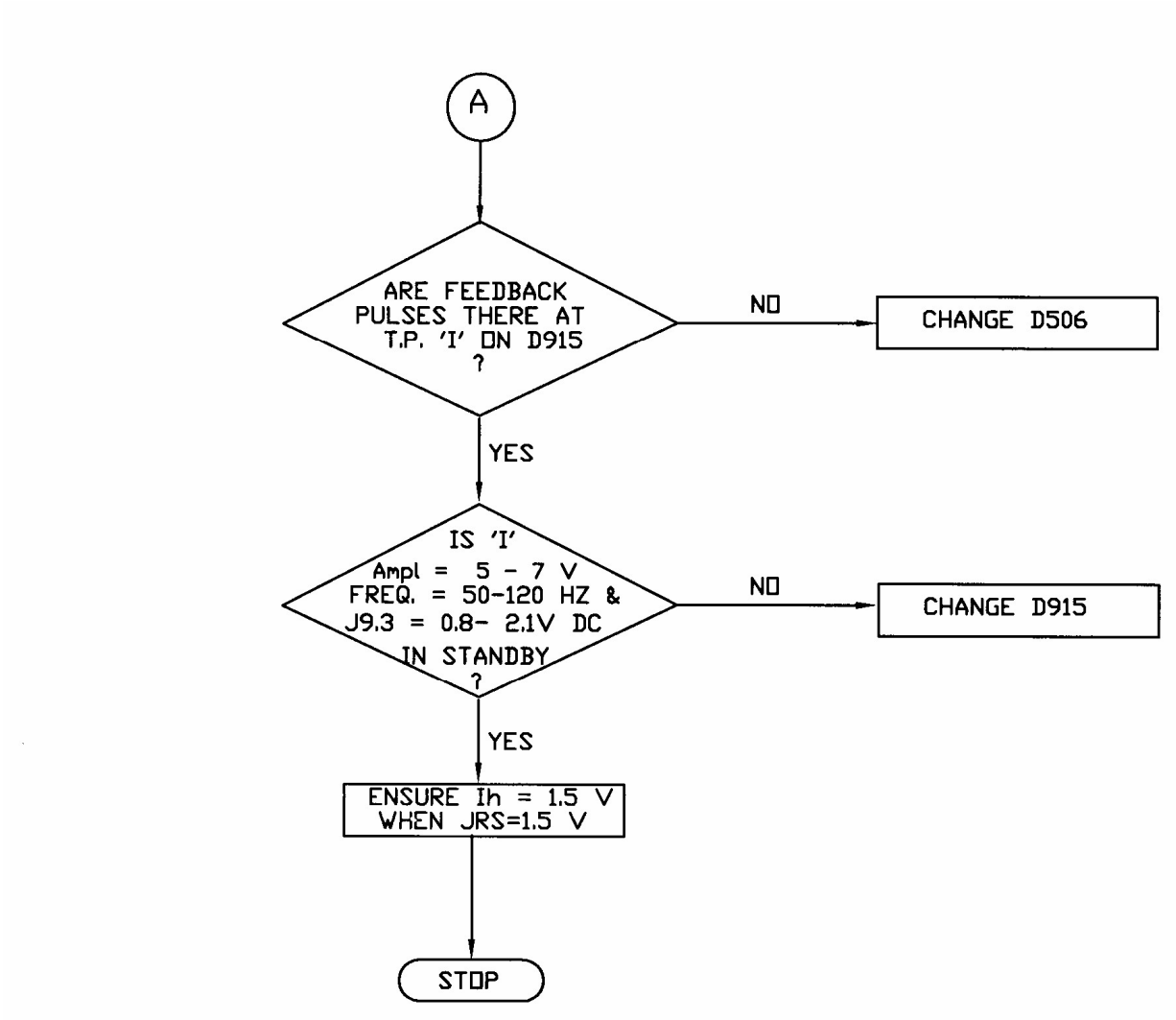
A
ARE FEEDBACK PULSES THERE AT T.P. 'I' ON D915 ?
NO
CHANGE D506
YES
IS 'I' Ampl = 5 - 7 V FREQ. = 50-120 HZ & J9.3 = 0.8- 2.1V DC IN STANDBY ?
NO
CHANGE D915
YES
ENSURE Ih = 1.5 V WHEN JRS=1.5 V
STOP

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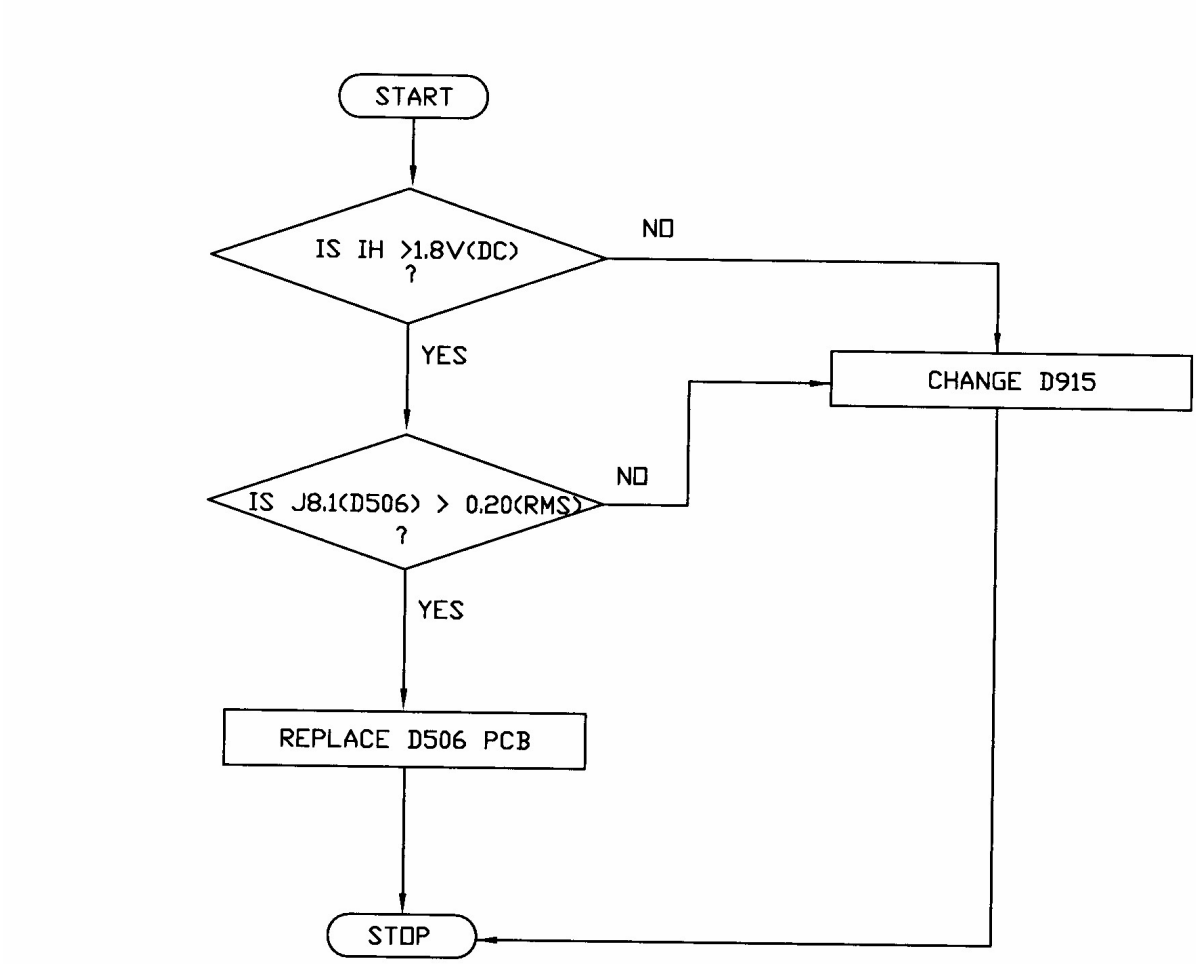

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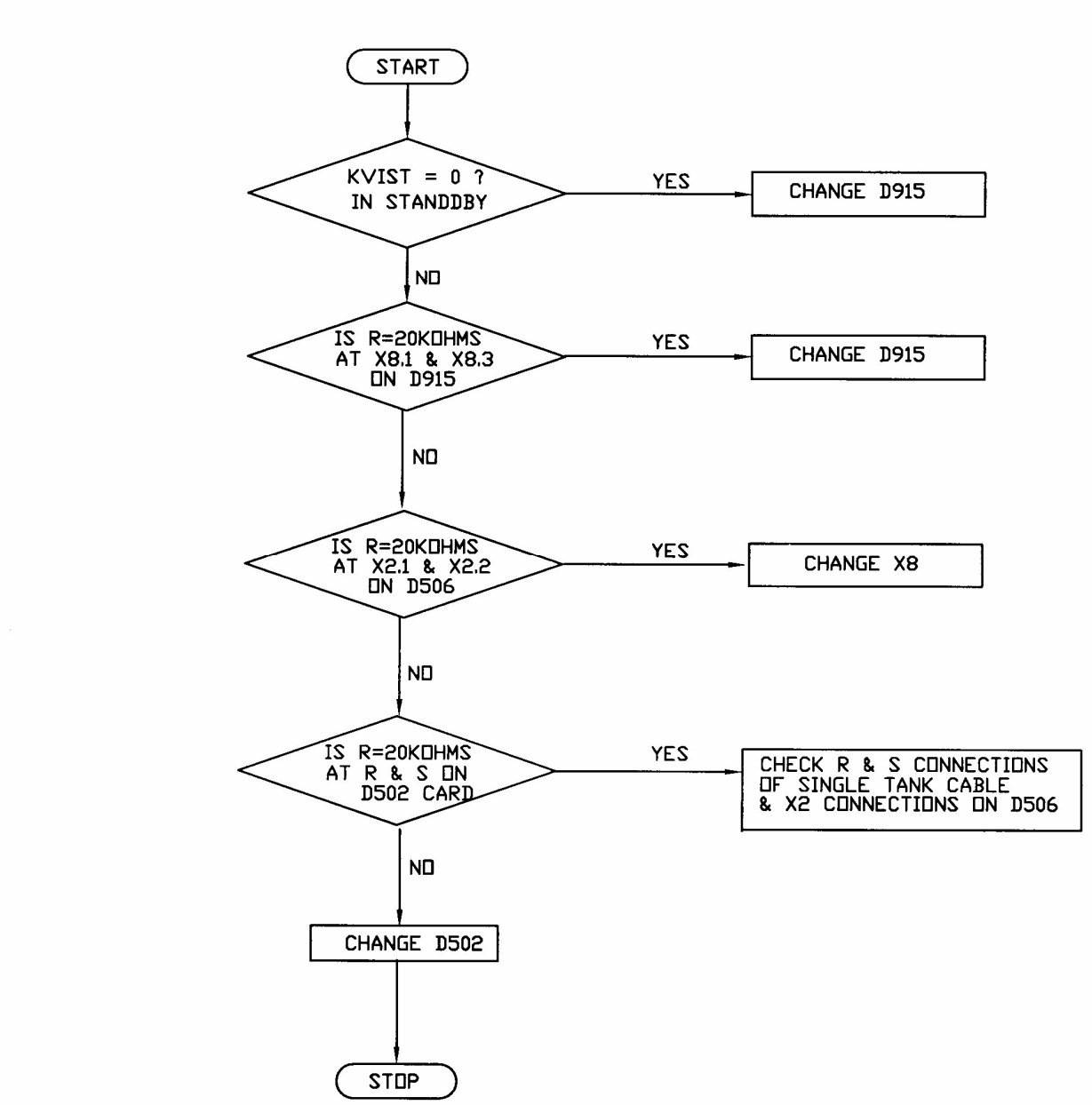
8.3.3 CodE 05 : kVist <> 0



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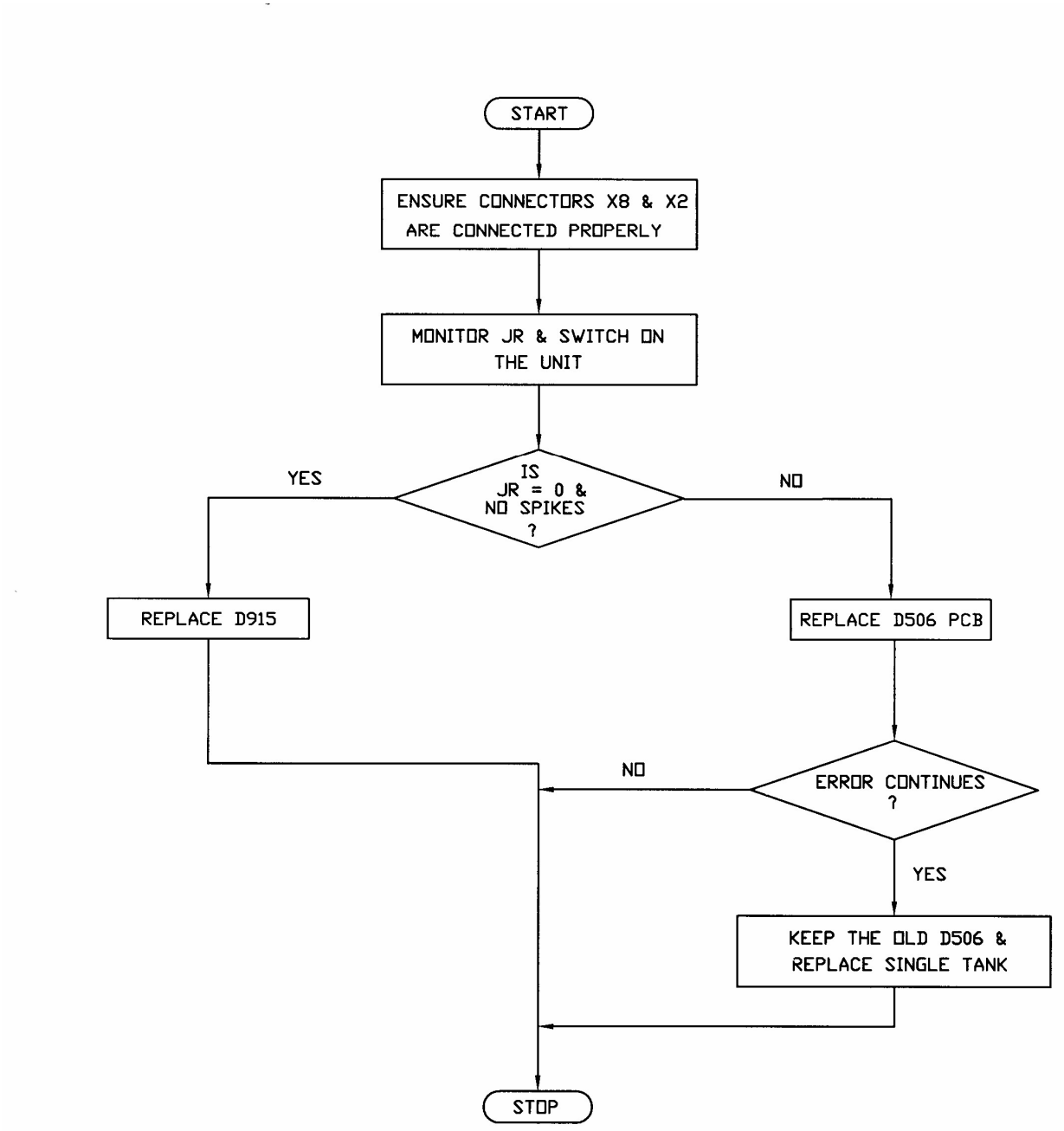
8.3.4 CodE 06 : JR <> 0



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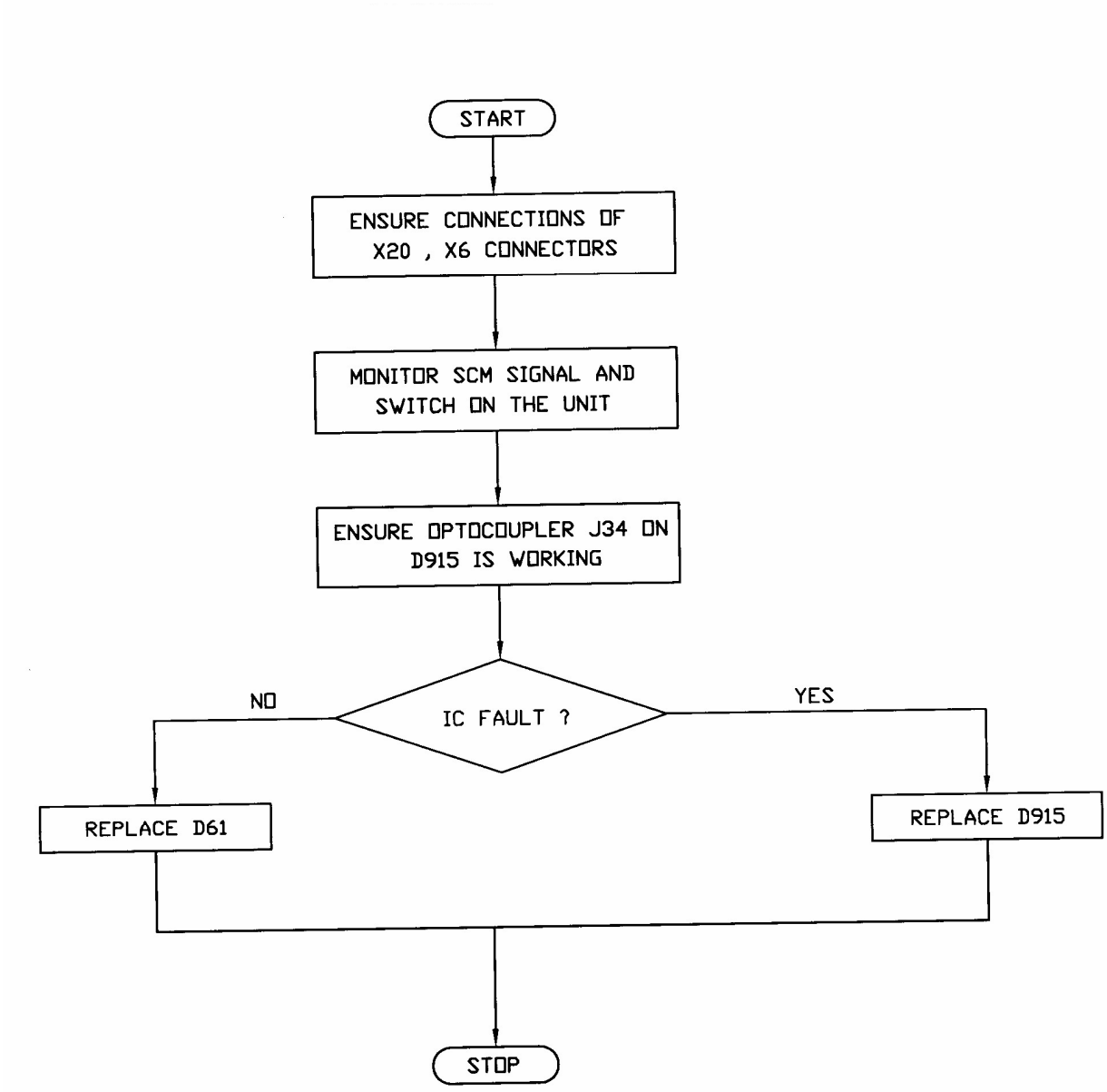
8.3.5 CodE 33 : Main Inverter Short Circuit



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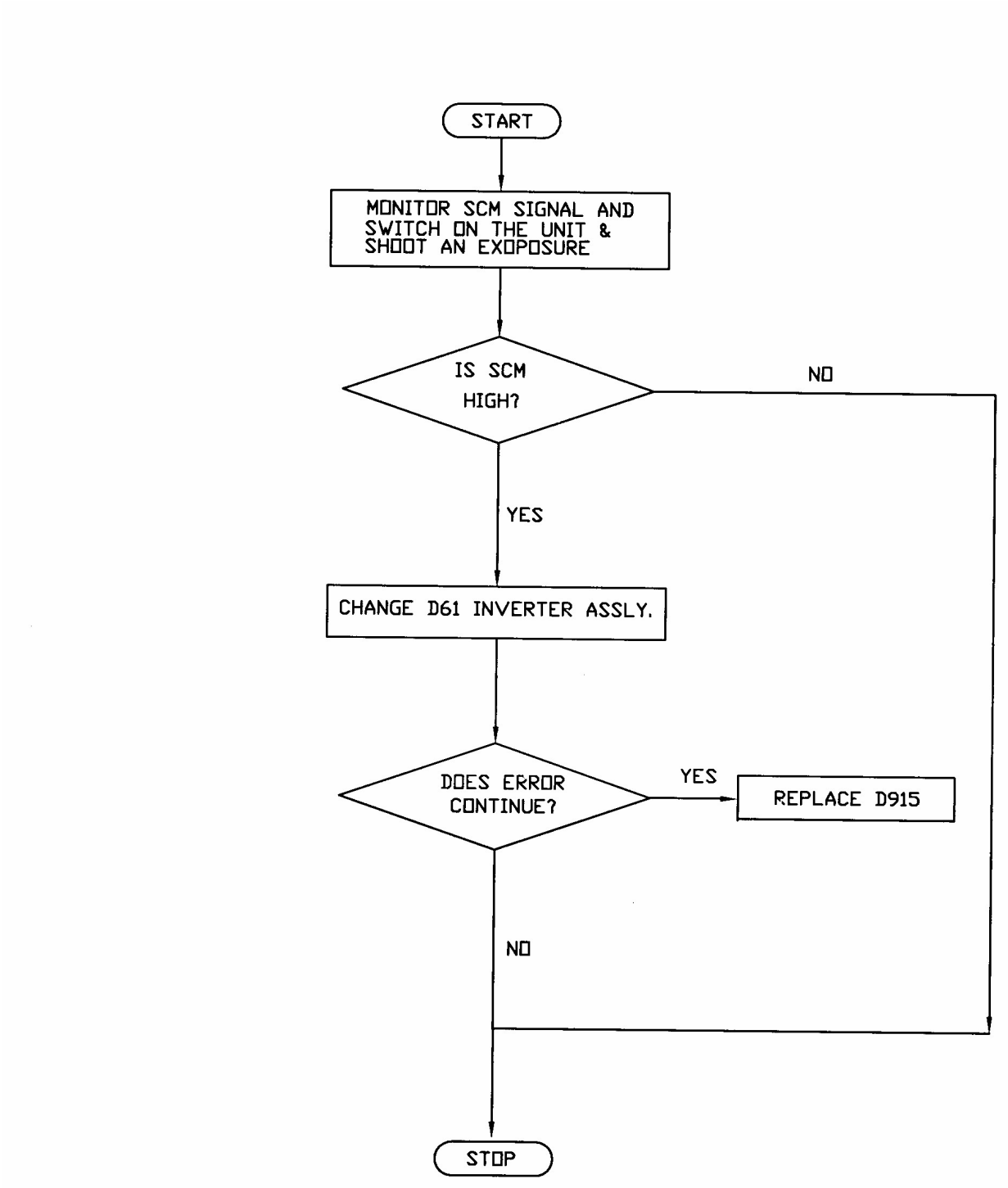
8.4 EXPOSURE ERROR CODES

8.4.1 CodE 11 : Main Inverter Short Circuit



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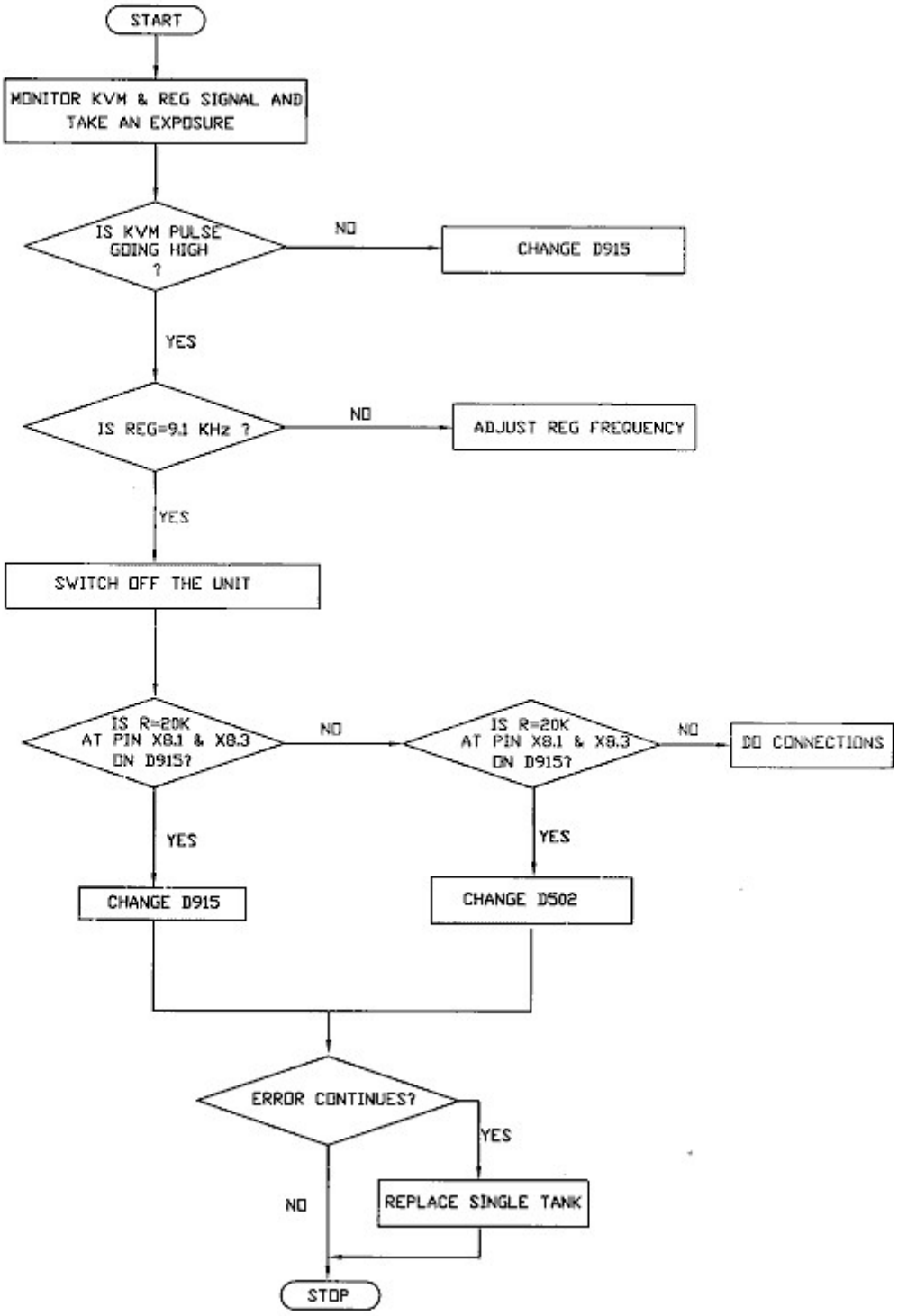
8.4.2 CodE 12 : kVist > kVmax



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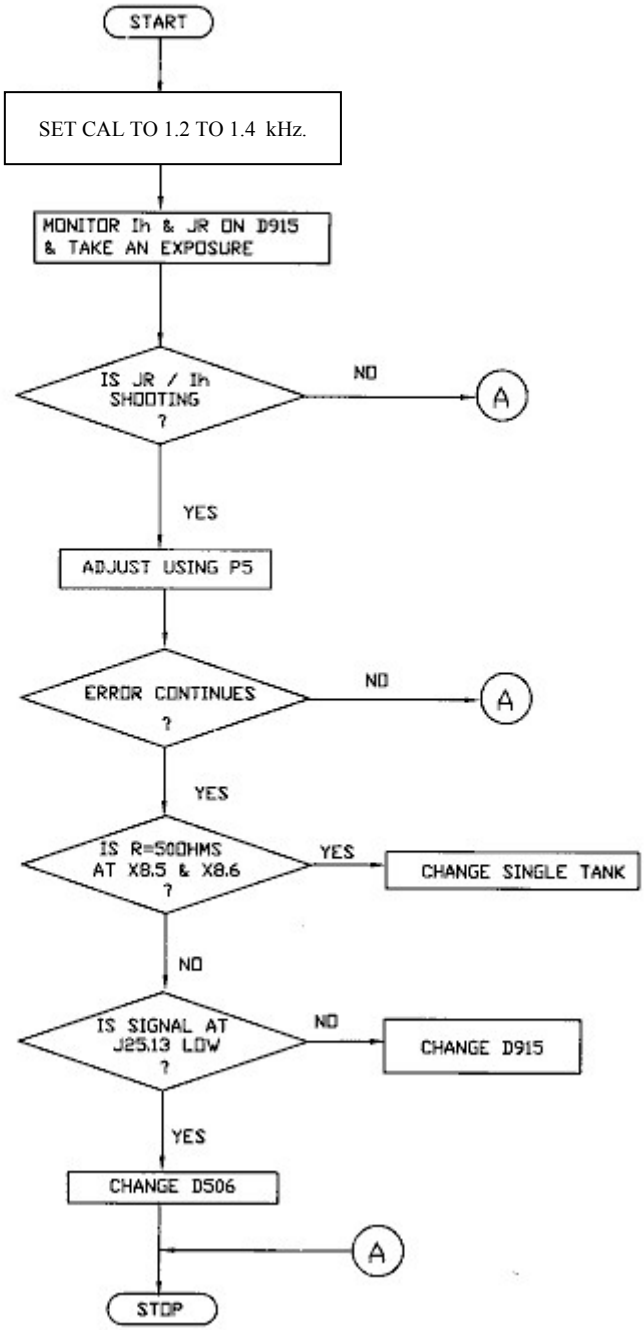
8.4.3 CodE 13 : Iheiz > Imax OR JR > Jrmax



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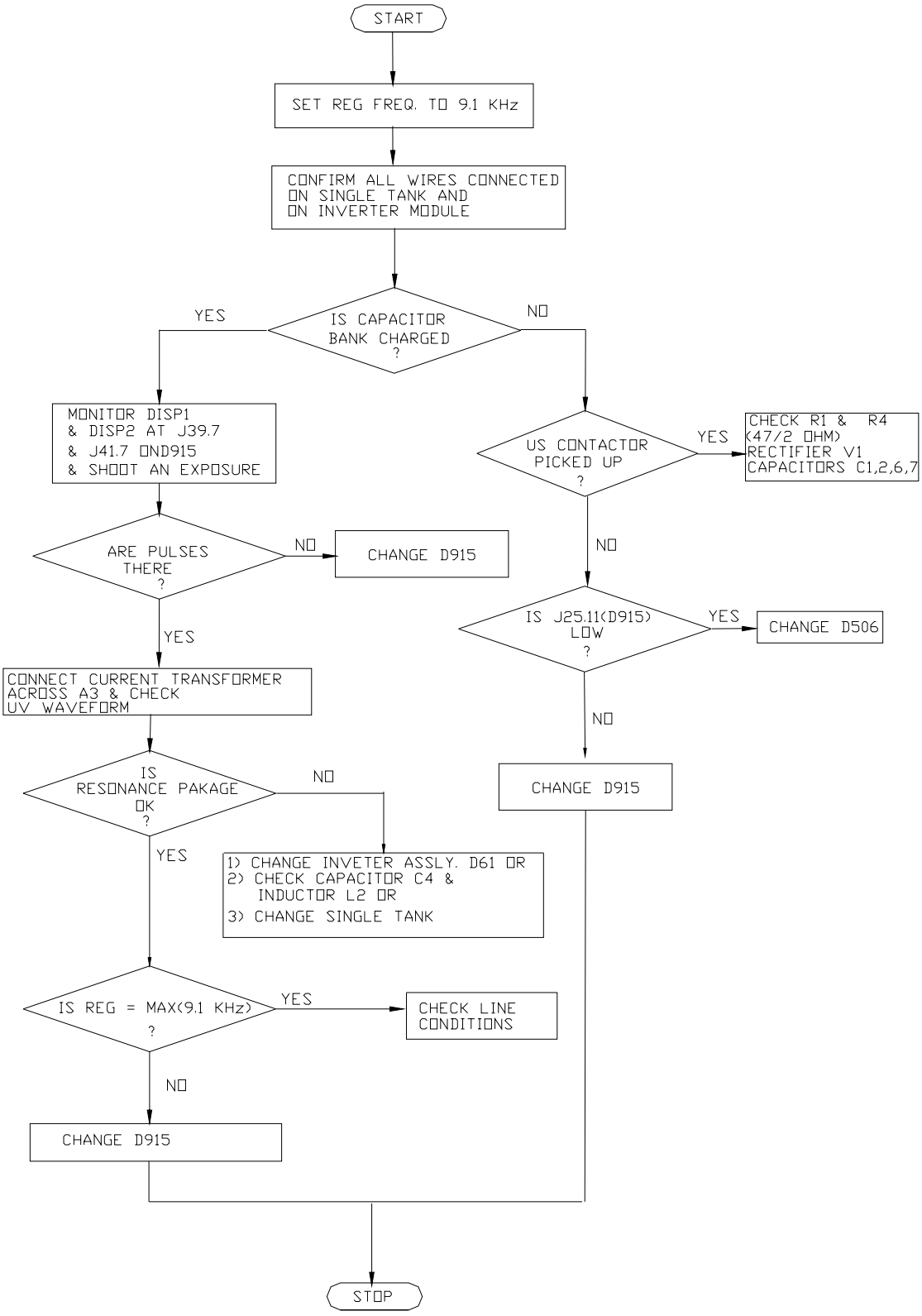
8.4.4 CodE 14 : kVist < kVsoll



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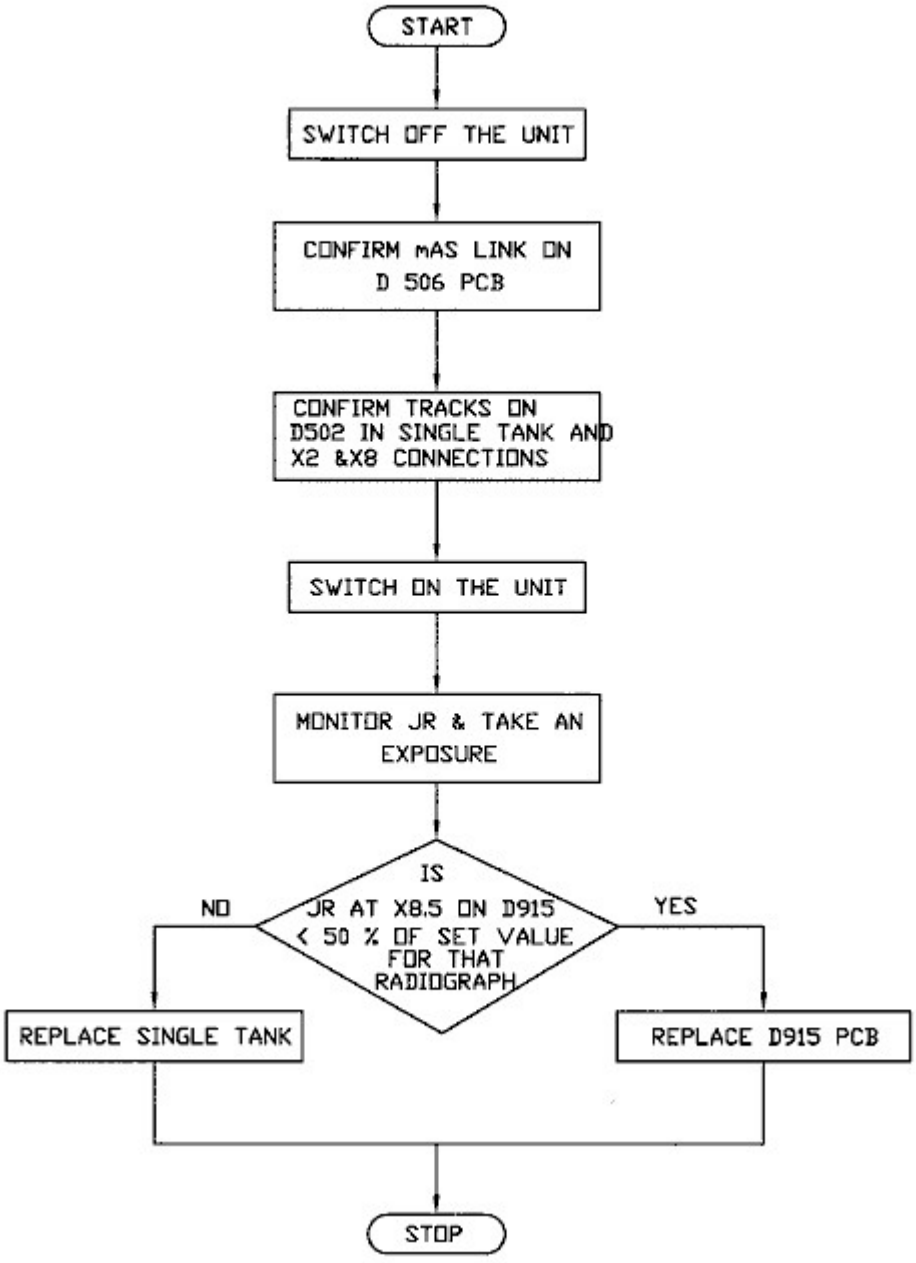
8.4.5 CodE 15 : JR < JRS


START
SWITCH OFF THE UNIT
CONFIRM mAS LINK ON D 506 PCB
CONFIRM TRACKS ON D502 IN SINGLE TANK AND X2 &X8 CONNECTIONS
SWITCH ON THE UNIT
MONITOR JR & TAKE AN EXPOSURE
IS JR AT X8.5 ON D915 < 50 % OF SET VALUE FOR THAT RADIOGRAPH
NO
YES
REPLACE SINGLE TANK
REPLACE D915 PCB
STOP

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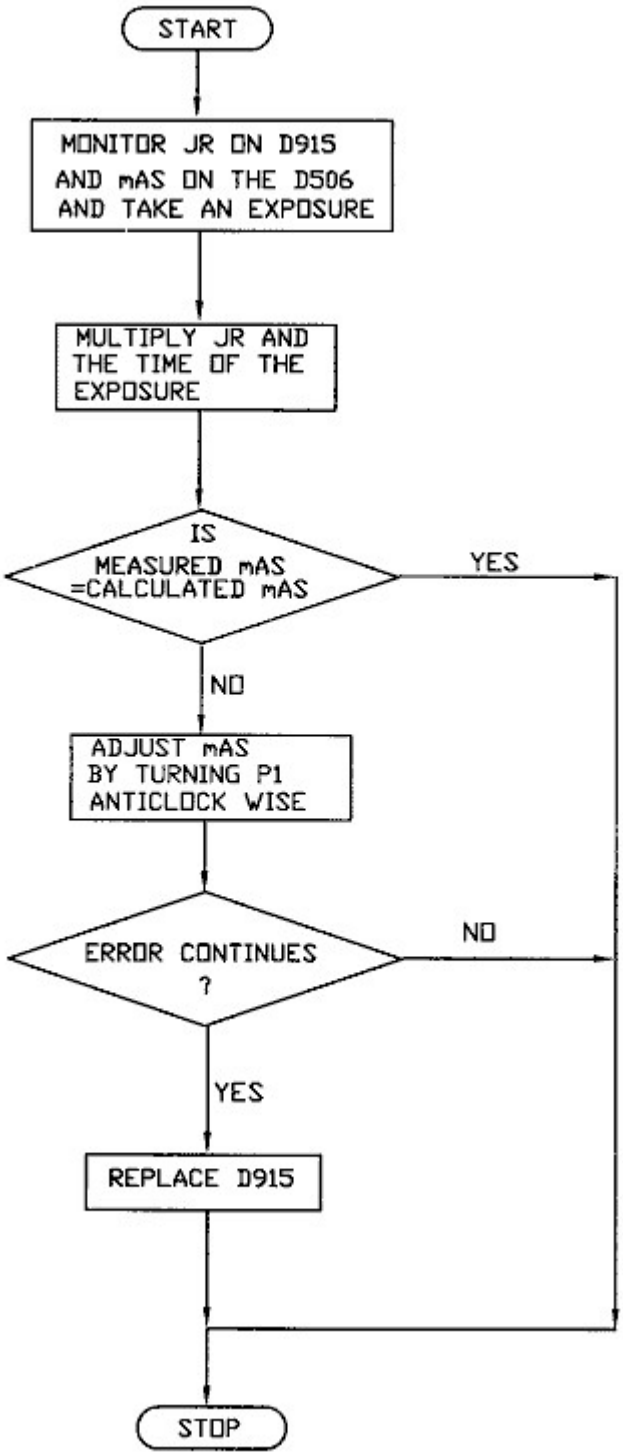
8.4.6 CodE 17 : Exposure terminated by Backup Timer



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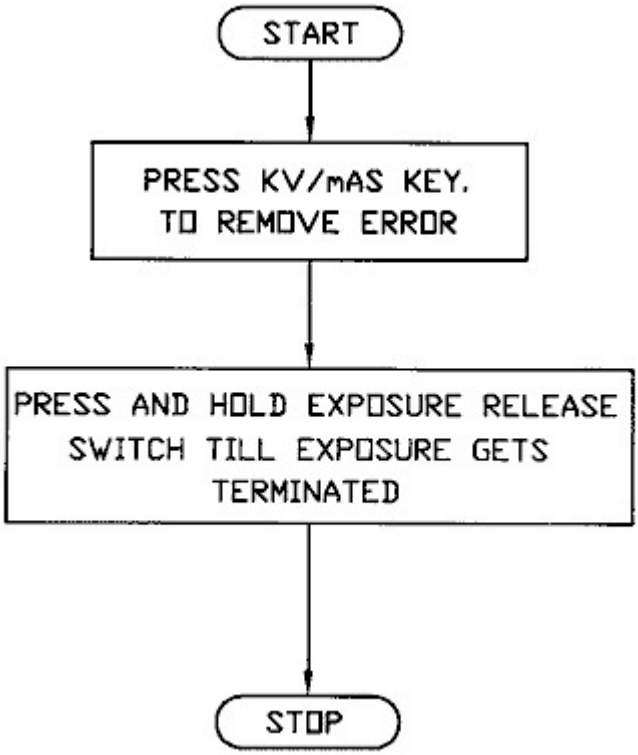
8.4.7 CodE 18 : Premature termination of Exposure



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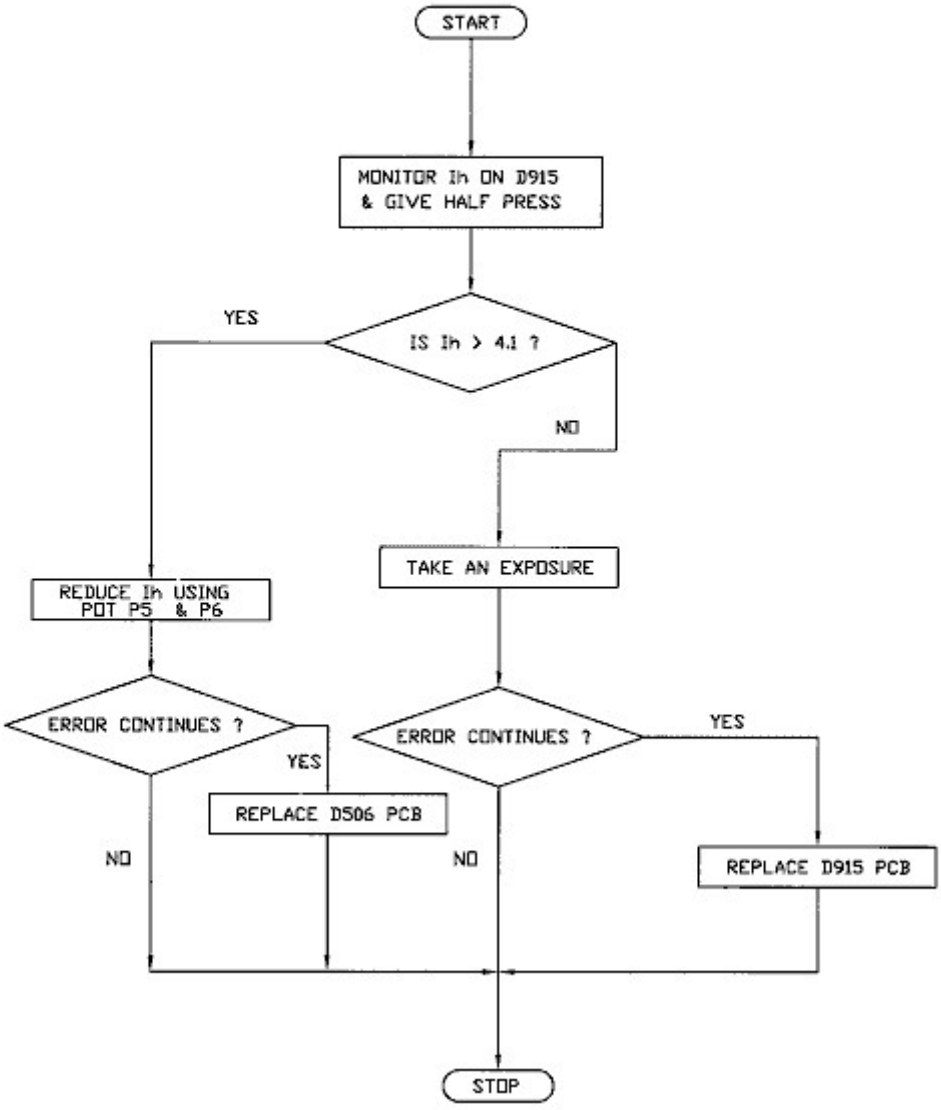
8.4.8 CodE 21 : Iheiz > Iheiz maximum



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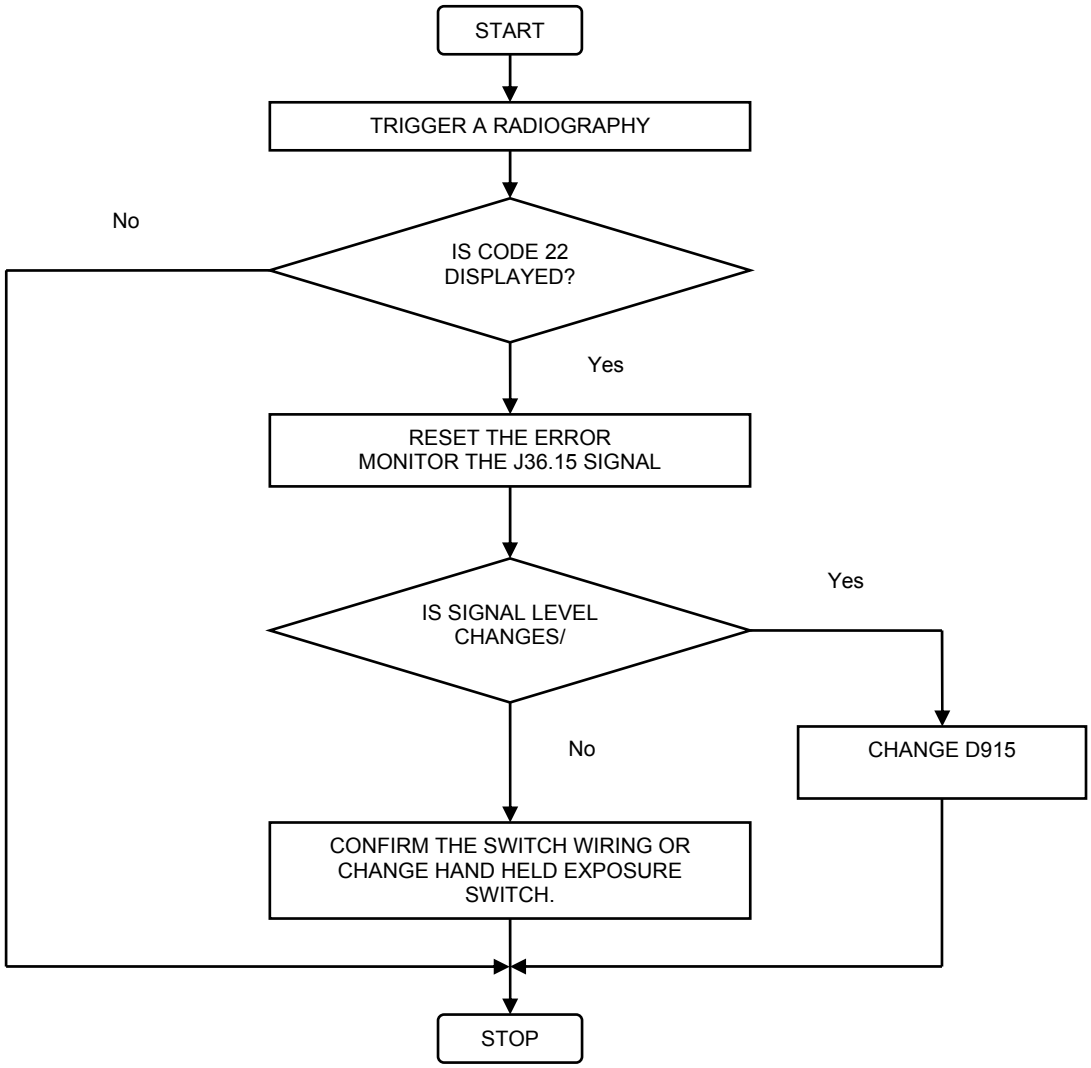
8.4.9 CodE 22: Maximum Preparation Time



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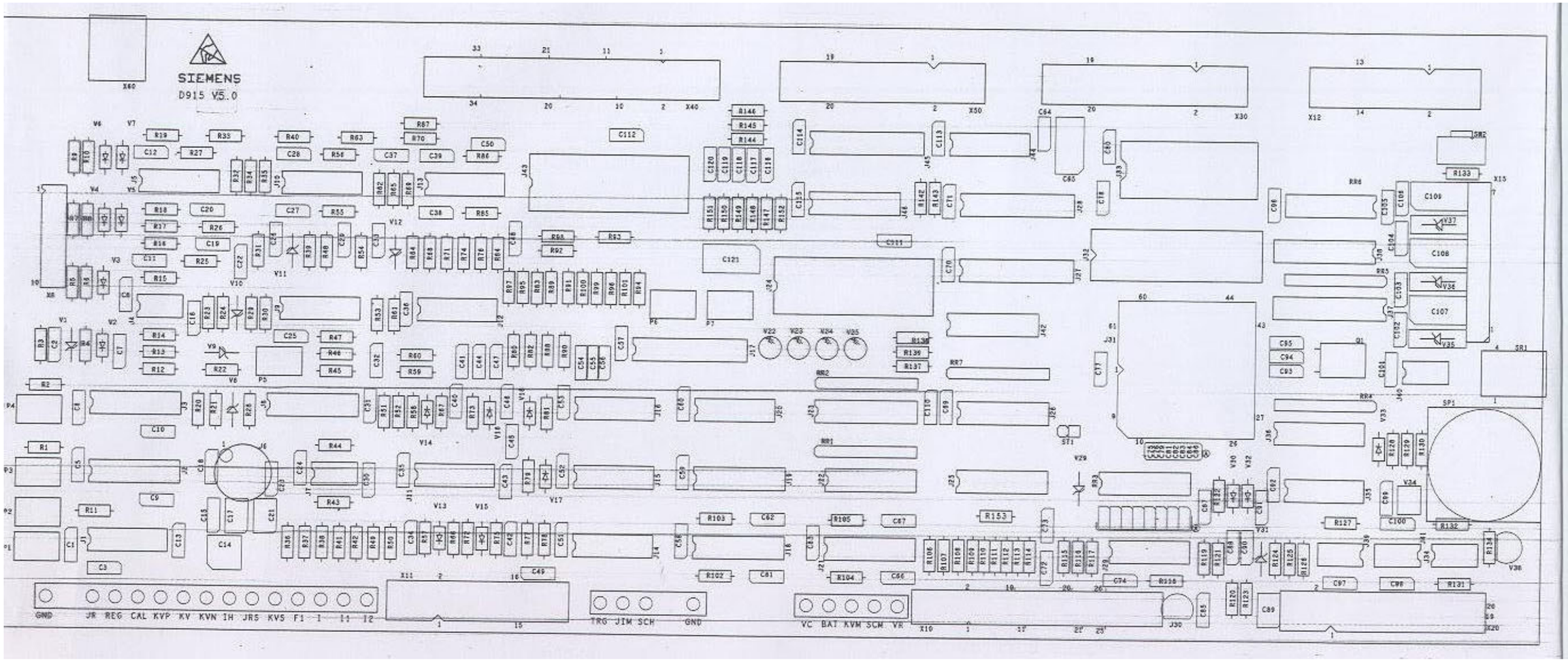
8.5 PCB Layout Drawings

8.5.1 Master card D915



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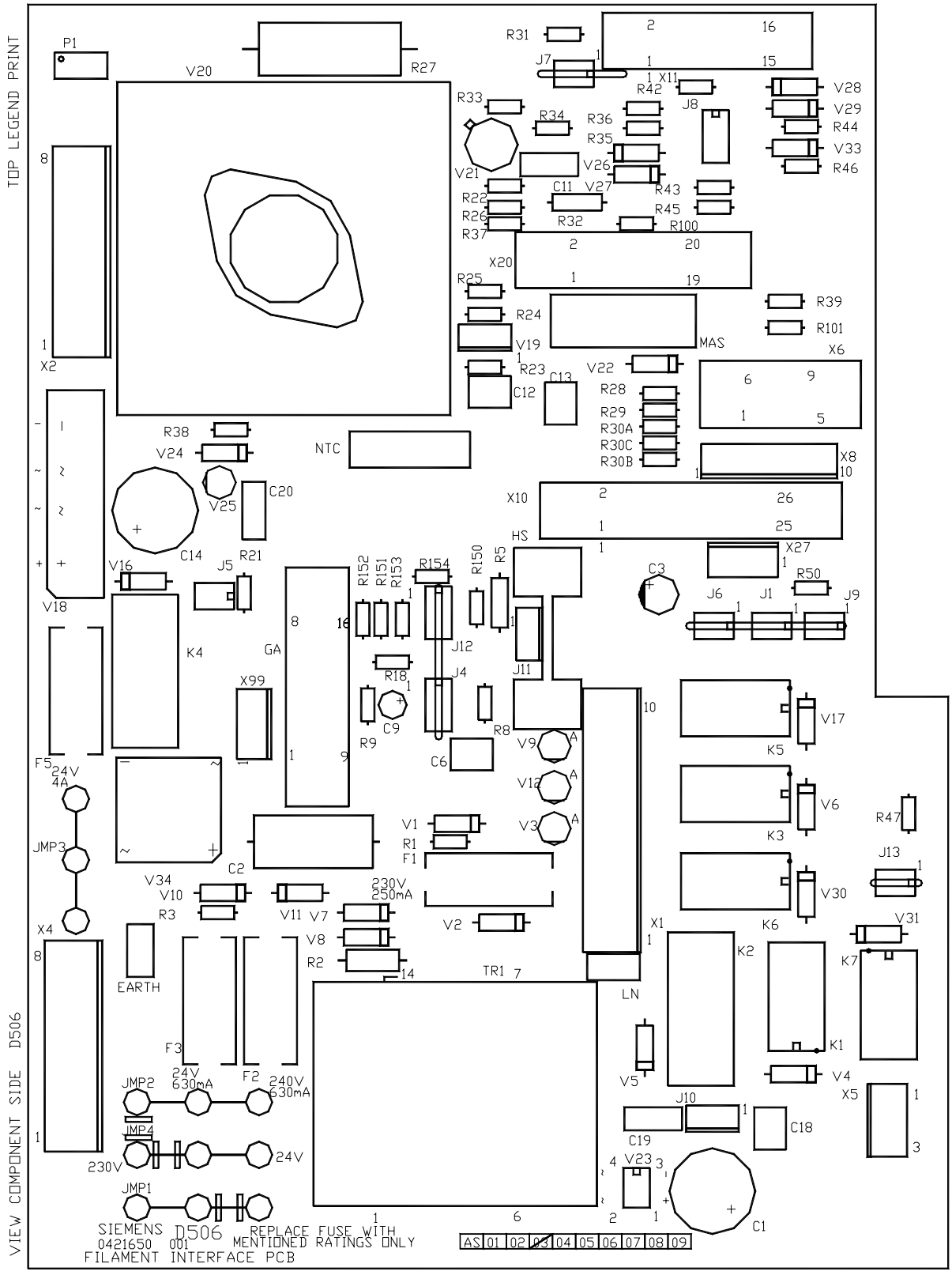
8.5.2 Filament interface PCB D506



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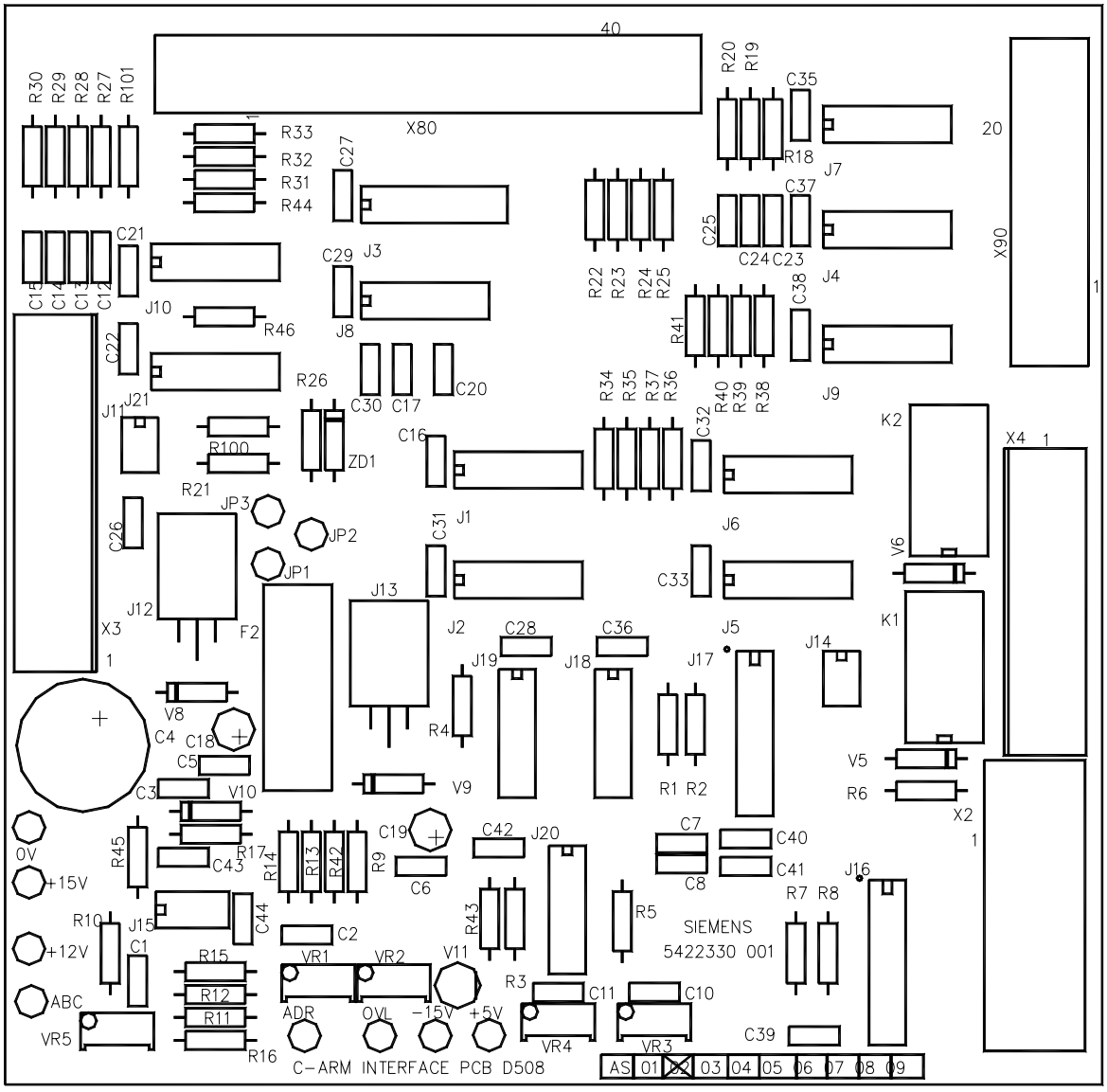
8.5.3 ADR and Collimator control PCB D508



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